UPPER MESOZOIC MICROFLORAS FROM SOUTH-EASTERN AUSTRALIA

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Abstract

Dispersed spores from Upper Mesozoic sediments of SE. Australia are described in detail and an account is given of their stratigraphical and geographical distribution. The samples examined are broadly representative of the partly marine Upper Mesozoic sequence developed in the South Australian portion of the Great Artesian Basin and the non-marine successions of the Otway Basin and E. Victoria. This paper includes systematic descriptions of 110 dispersed-spore species embracing 60 genera. 25 new species and 5 new genera are proposed, and the diagnoses of 7 genera have been amended. Serial sections of 28 species, including azonate, zonate, and saccate forms, are discussed, and it is shown that sections aid the elucidation of wall features. Consideration is given to relevant problems in dispersed-spore nomenclature and taxonomy, and the system initiated by Potonié and Kremp for the classification of forms referable to the Anteturma Sporites H. Potonié is revised. Botanical relationships are indicated for certain of the spore taxa. 3, distinct, successive, microfloral assemblages are distinguishable in sediments examined from the Great Artesian Basin and from elsewhere in SE. Australia. The presence in each of the microfloras of species recorded previously from both within and without Australia permits inter-Australian and world-wide correlation. Evidence is adduced as to the ages of the microfloras and it is concluded that they are of probable lowermost Cretaceous (Valanginian or older), Valanginian-Aptian, and Aptian-Albian ages respectively.

Introduction

The present account incorporates the results of a detailed investigation of dispersed spores from SE. Australian Upper Mesozoic strata. The object of this study was twofold: firstly, to describe systematically the spores, and secondly, to utilize the spores in the inter-Australian and world-wide correlation of SE. Australian Upper Mesozoic sediments.

Results of preliminary palynological (spore) analyses of Mesozoic deposits from E. Australia were presented by Cookson (1953, 1954), Cookson and Dettmann (1958a, b; 1959a, b), and Dettmann (1959). These authors demonstrated that regional correlations of E. Australian Mesozoic strata are possible by means of the microfloras contained therein. The material upon which their investigations were based include marine and non-marine samples from scattered outcrops and bore sequences in the Great Artesian Basin, Victoria, Queensland, and Papua. The majority of the samples yielded diverse and well-preserved microfloras which suggested a Lower Cretaceous age. Further evidence for such an age is provided by numerous other samples, recorded herein, from well-documented reference sequences in the Great Artesian and Otway Basins.

Many of the SE. Australian spore types are referable to spore species previously described from other parts of the world. The spore species are based on morphological criteria and are assigned to similarly based generic categories (form genera). These form categories are classified into an artificial system since the botanical affinities of the larger majority of pre-Quaternary dispersed spore forms are unknown. Nomenclature of the taxa of generic and lower rank is determined by the rules of priority and typification as laid down in the International Code of Botanical Nomenclature (1961, Montreal). Unlike nomenclature, classification of the spore entities is not subject to any international control, and various classification systems have been formulated since palynology was founded during the last century.

The most comprehensive classification scheme presented to date is the one first proposed by Potonié and Kremp (1954) and subsequently amplified by these authors (1955, 1956) and Potonié (1956, 1958, 1960). This system, however, is not entirely satisfactory in that many of the suprageneric categories are arbitrarily based, and hence the framework of the system lacks complete uniformity. Certain of the anomalies in Potonié and Kremp's system are considered subsequently, and the scheme presented by these authors for the classification of Sporites H. Potonié is revised.

Within the systematic section certain important European Mesozoic spore species instituted by Delcourt and Sprumont (1955) and Couper (1958) are redescribed. The descriptions are based on type specimens from the collections of M. Delcourt, Ath, Belgium, and of the Sedgwick Museum, Cambridge. In addition, a Lower Tertiary species that was originally described by Cookson (1947) from Kerguelen is redefined on the basis of the holotype and of additional specimens obtained from a sample lodged in the British Museum of Natural History.

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FIG. 1—Map of SE. Australia showing principal outcrops of Upper Mesozoic strata (in heavy black), approximate boundaries of sedimentary basins, and location of samples investigated.

Outline of Stratigraphy

Upper Mesozoic sediments of SE. Australia are most extensively exposed in the S. portion of the Great Artesian Basin, the Otway Basin, and in E. Victoria. They have also been encountered in water bores and oil exploratory wells in the Murray Basin. Bore and outcrop samples collected from these areas constitute the basis of the present study; the sampling localities are indicated on Fig. 1, and a summary of the data relevant to the samples is presented in Appendix II. The collections are far from comprehensive but are broadly representative of the partly marine Upper Mesozoic sequence of the South Australian portion of the Great Artesian Basin and the non-marine sequences developed in the Otway Basin and E. Victoria. A brief summary of the Mesozoic stratigraphy in each of these areas is presented below. Age deductions quoted are largely those based on faunal, microplankton, and megafloral evidence; a reappraisal of the ages of the megafloras recorded from the strata under consideration and a brief account of previous palynological investigations on Australian Upper Mesozoic strata is incorporated in subsequent sections of this paper.

Great Artesian Basin (South Australian Portion)

This area, as defined by Sprigg (in Glaessner and Parkin 1958), occupies the NE. part of South Australia, E. from longitude 134°E and N. from latitude 31½°S (see Fig. 1). Within this area Upper Mesozoic sediments are extensively exposed about the Stuart Ranges and near the Queensland and Northern Territory borders where they attain a thickness of over 5,000 ft. Along the SW. margin of the basin Upper Mesozoic rocks rest unconformably on Permian shales and intercalated coals, and around, and northwards from, Lake Eyre and Lake Frome they are overlain by Tertiary sandstones.

As outlined by Sprigg (in Glaessner and Parkin 1958), equivalents of the Upper Mesozoic Blythesdale and Rolling Downs Groups, which are typically developed in Queensland, are represented in the South Australian portion of the Great Artesian Basin. The formational nomenclature used by these authors is adopted here, although it is now understood that new formational names are to be proposed for use in South Australia (fide N. H. Ludbrook). Samples from two bores (Oodnadatta Bore No. 1 and Cootabarlow Bore No. 2) sunk in the South Australian portion of the Great Artesian Basin form an important basis for the present study; the bore successions and the intervals that have been examined palynologically are depicted on Fig. 2 (see also Appendix II).

Blythesdale Group

Sediments of this group consist of sandstones, grits, and subordinate shales. Exposures on the eastern slopes of the Flinders Ranges contain non-marine molluscs, thought to be Lower Cretaceous (Neocomian) in age (Ludbrook 1961a), and megaplants (Glaessner and Rao 1955, see also Woodard 1955). Horizons in the 1,052-61 ft interval in the Oodnadatta bore have been determined as Aptian or older on the basis of microplankton (Cookson and Eisenack 1960b; Eisenack and Cookson 1960). Sprigg (in Glaessner and Parkin 1958, p. 91, 94) states that the Blythesdale Group as developed in South Australia 'may include pre-Cretaceous deposits, such as equivalents of the Jurassic Walloon Formation of Queensland, and even Triassic'.

Rolling Downs Group

Exposures of this group occur over wide areas in South Australia. Its accepted subdivisions, the Roma Formation (marine Aptian), Tambo Formation (marine

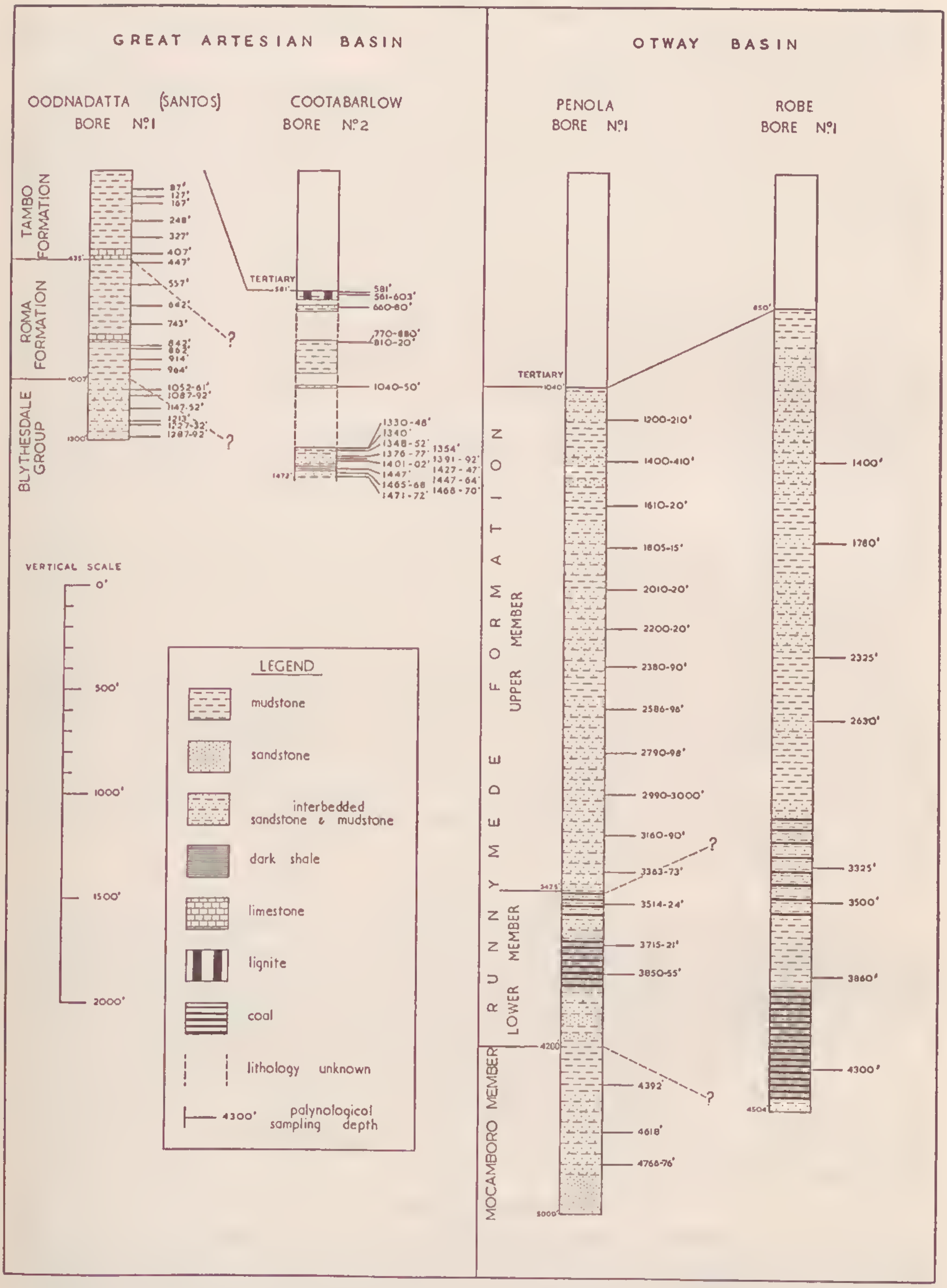

FIG. 2—Stratigraphical columns of the Upper Mesozoic sequences intersected in Oodnadatta (Santos) Bore No. 1 and Cootabarlow Bore No. 2 in the Great Artesian Basin and Penola Bore No. 1 and Robe Bore No. 1 in the Otway Basin. The columns have been compiled from data given by Sprigg in Glaessner and Parkin (1958), Whittle and Chebotarev (1952), O'Driscoll (1960), and Ludbrook (1963a, b).

Albian), and the Winton Formation (lagoonal to lacustrine Upper Cretaceous) can only be adequately distinguished on palaeonotological evidence; lithological criteria are of limited application (Sprigg loc. cit.).

The Roma Formation which is exposed in the marginal areas of the basin consists of dark mudstones, siltstones, and occasional sandy bands and calcareous layers. In the Oodnadatta bore the sequence is 570 ft thick and contains several species of *Maccoyella* identical to those described from the four ammonite stages of Queensland (Sprigg loc. cit.). The Queensland ammonite stages have been correlated with four stages of the European Aptian by Whitehouse (1926) who demonstrated that, in the absence of ammonites, the evolutionary series of the maccoyellids can be used for zoning. Sprigg (loc. cit.) quotes that the four Queensland stages as well as an additional upper stage are represented in the Oodnadatta bore. Strata at 1,354 ft in Cootabarlow Bore No. 2 are believed to be Aptian on the basis of foraminifera (Ludbrook 1963a; South Australian Department of Mines Palaeontological Report 14/56, 1956 unpublished) and microplankton (Cookson and Eisenack 1958).

The Tambo Formation outcrops in the SW. part of the basin and includes richly fossiliferous calcareous shales with limestone layers and interbedded sandstones which total about 650 ft in thickness. In the Oodnadatta bore the basal beds, termed the 'Terebratella beds', rest conformably on the Roma Formation. The 'Terebratella beds' contain *Lingula* and *Terebratella* and are assigned to the Lower Albian (Sprigg loc. cit.). Stratigraphically higher beds contain a rich Middle and Upper Albian fauna characterized by *Falciferella, Aucellina, Inoceramus,* and *Dimitobelus* (Sprigg loc. cit.; Brunnschweiler 1959).

Exposures of the Winton Formation occur in the NE. part of the state and consist of shales, siltstones, sandstones, and interbedded layers of sandy limestones comprising a thickness of 350 ft. Freshwater molluscs (*Unio* sp.) and megaplant remains (*Brachyphyllum, Elatocladus*) have been recorded from the sediments which are considered to be early Upper Cretaceous (probably Cenomanian) in age (Sprigg loc. cit.; Sprigg in Cookson and Dettmann 1959b). Microfloras recovered from samples (Haddon Downs Bore No. 5) of this formation have not been described in detail; only previously described species, the majority of which occur also in the underlying formations, are recorded (see Tables 5, 6).

Murray Basin

The Murray Basin embraces a large area in New South Wales and the adjoining areas in South Australia and Victoria (see Woods 1883; Ludbrook 1961b; Condon, Fisher, and Terpstra 1960; present study, Fig. 1). This area is covered by Tertiary strata, but Mesozoic sediments have been encountered in bores sunk at Loxton. Carbonaceous shales from 1,586 ft in one of these bores (Australian Oil and Gas Corporation, Loxton Bore) contain an impoverished and poorly preserved foraminiferal fauna, and 'on somewhat negative evidence, the age of the sediments was determined as Albian' (Ludbrook 1961b, p. 12). Two samples taken from above this level (at 1,465-70 ft and 1,410-15 ft) in the same bore have been investigated in the present study.

Otway Basin

This basin, as recently defined (see McQueen 1961; Condon et al. 1960; present study, Fig. 1), occupies the area S. of the Padthaway Horst in South Australia (Gambier Sunklands) and SW. Victoria (Portland Sunklands). Non-marine Mesozoic sediments outcrop in the valley of the Glenelg River (Merino Group), the

Otway Ranges (Otway Group), and the Barrabool Hills (Barrabool Sandstone) and have been encountered in bores elsewhere in W. Victoria and SE. South Australia.

Bores sunk in Victoria, at Nelson, Port Campbell, and Port Fairy, have penetrated marine Upper Mesozoic strata which rest on probable equivalents of the Otway Group and which are overlain by Tertiary rocks. Cores retrieved from a bore at Port Fairy (Belfast Bore No. 4) contain several incomplete ammonite specimens of probable Upper Cretaceous age (Kenley 1959) and microplankton indicative of a Senonian age (Cookson and Eisenack 1961). Senonian microplankton assemblages occur in the Nelson Bore sediments between 5,304 ft and 6,233 ft (Cookson and Eisenack 1960a, 1962; see also Baker and Cookson 1955); the upper horizon of this interval also contains *Cyclammina* (Crespin 1954). Marine Upper Cretaceous strata have not been examined in the present study, since these sediments are being investigated palynologically by Dr P. R. Evans of the Bureau of Mineral Resources and Mr J. G. Douglas of the Mines Department of Victoria. Cookson and her collaborators and Douglas (1961a) have already recorded several spore and microplankton species from certain of the Upper Cretaceous horizons.

The Merino Group rests with angular unconformity on Palaeozoic rocks and consists of carbonaceous siltstones and mudstones (Mocamboro Member) disconformably overlain by felspathic sandstones and mudstones of the Runnymede Formation (Kenley 1954). Both units contain megafloras which, according to Kenley (loc. cit.) and Medwell (1954a, b), indicate a Lower-?Upper Jurassic age for the Mocamboro Member and a Lower Cretaceous age for the Runnymede Formation. Probable equivalents of the Merino Group have been intersected beneath Tertiary strata in bores at Penola, Robe, and Comaum in South Australia. Penola Bore No. 1 passed through almost 4,000 ft of Mesozoic sandstones, siltstones, mudstones, and subordinate coals before drilling was abandoned; the sediments below 4,200 ft are thought to be equivalents of the Mocamboro Member and those in the 1,054-4,200 ft interval probably represent the Runnymede Formation (Ludbrook 1963b; present study, Fig. 2). Ludbrook (1961b) tentatively suggested that the Runnymede Formation is represented both in Comaum Bore No. 2 (between 650 ft and 708 ft) and in Robe Bore No. 1 (between 1,400 ft and 4,300 ft).

(Note: The stratigraphic terms Runnymede Formation and Mocamboro Member have been used here in the sense of the O.D.N.L. Penola No. 1 well completion report (Cundill and Bollen 1961, Ludbrook 1963b). The present work provides no independent evidence as to the validity of the correlation of these units with beds at the type section, Killara Bluff, originally described by Kenley (1954).)

Sediments lithologically similar to those of the Merino Group form the Otway Group in the Otway Ranges and the Barrabool Sandstone in the Barrabool Hills. The latter unit also contains conglomerates near the base which rests on Silurian strata (Coulson 1930, 1960). Megafloras from both units were re-assessed by Medwell (1954a) who assigned the strata to the Lower Jurassic.

Eastern Victoria

Mesozoic sediments of E. Victoria consist of a non-marine sequence of interbedded mudstones and felspathic sandstones together with minor amounts of grits, conglomerates, and bituminous coal seams (Edwards and Baker 1943). They outcrop over large areas in the Gippsland Highlands (Strzelecki Group), where the Wonthaggi Coal Measures are developed, and N. of the Latrobe River (Tyers Group). To the E. of Wonthaggi over 5,000 ft of non-marine Mesozoic sediments occur beneath Tertiary strata in the Gippsland Sunklands (Webb 1961; Boutakoff 1956). Cores (between 3,949 ft and 4,004 ft) from Bengworden South Bore No. 1

sunk in the Gippsland Sunklands have yielded Cretaceous foraminifera (Taylor in Webb 1961); one of the cores (from 3,977 ft) has been investigated in the present study.

Comprehensive accounts of the geology of the Strzelecki Group are given by Edwards and Baker (1943) and Edwards, Baker, and Knight (1944) who estimate that the strata total 4,000 ft in thickness. Plant megafossils occur in many horizons and have recently been estimated as indicative of a Lower Jurrasic age (Medwell 1954a).

As outlined by Philip (1958) the sediments of the Tyers Group total 2,000 ft in thickness and rest unconformably on Siluro-Devonian strata. Plant megafossils have been reported from several horizons, including the massive basal conglomerates (Douglas 1962; see also Medwell 1954a). Medwell assigned the megafloras that she investigated to the Lower Jurassic.

Victorian and South Australian Mesozoic Megafloras

Much has been written about Victorian Mesozoic megafloras (the Triassic Bacchus Marsh flora is excluded from this account), the ages and identifications of which have been subject to some controversy since the middle of the nineteenth century. An important contribution to our knowledge of megafloras contained in strata of the Strzelecki and Otway Groups was presented by Seward in 1904. However, a comprehensive account of Victorian Mesozoic megafloras was lacking until 1954 when Medwell re-examined all available material collected from the Tyers, Strzelecki, Otway, and Merino Groups and the Barrabool Sandstone. According to Medwell (1954a) the megaplants are preserved as carbonaceous impressions, and, with the exception of two gymnospermous species studied by Florin (1952) and Douglas (1961b), their cuticular structure is unknown. In situ spores have not been reported despite the fact that fertile filicean specimens were illustrated by Seward (1904).

The collection studied by Seward (1904, p. 183) includes 10 forms which he considered as 'almost indistinguishable' from types represented in the Inferior Oolite Series of England and the Rajmahal Formation of India. These comprise: **Lycopodites victoriae* Seward, **Coniopteris hymenophylloides* Brongn. var. *australica* Seward, *Taeniopteris daintreei* McCoy (= *T. spatulata* Oldham & Morris), **Cladophlebis denticulata* Brongn. var. *australis* Seward (= *C. australis* (Morris)), *Baiera australis* McCoy (= *Ginkgoites australis* (McCoy)), *B. delicata* Seward, *Nilssonia* sp., *Araucarites* sp., *Ginkgo* sp., and *Taxites* sp. On this evidence Seward assessed that the flora is of a Jurassic age. Three representatives of the Pteridophyta marked * above are now considered by Harris, T. M. (1961) to be distinct from the English Middle Jurassic species with which they originally were compared; Harris's forthcoming account of the Gymnospermae of the Yorkshire flora may well provide further information as to the precise identity of the Victorian gymnospermous species.

Medwell (1954a) after re-examining collections studied by McCoy (1867 and later), Chapman (1908, 1909), Seward (1904), and others concluded a Lower Jurassic age for the flora. This age estimation was based on the occurrence of 'both Triassic and Jurassic elements' (Medwell 1954a, p. 102). The 'Triassic elements' include *Neocalamites, Dicroidium, Thinnfeldia, Ginkgoites,* and *Czekanowskia* which occur in the Triassic floras of Tasmania and/or Queensland (Ipswich, Esk, Bundamba). However, *Neocalamites, Thinnfeldia, Ginkgoites,* and *Czekanowskia,* at least, are now known from Jurassic ('Walloon') and Lower Cretaceous (Blythesdale, Burrum, and Styx floras of Queensland (see Bryan and Jones 1946, Walkom

1928, Whitehouse 1955, Hill and Denmead 1960). The 'Jurassic elements' include *Sphenopteris hispoli* Oldham & Morris, *'Coniopteris hymenophylloides', Cladophlebis australis, Taeniopteris spatulata, T. crenata* McClelland, *Araucarites*, etc. As noted by Medwell the majority of these forms occur in the Indian Rajmahal Formation (see Sitholey 1955), from which Spath (1933) reported Lower Cretaceous ammonites. Arkell (1956) supports Spath and quotes an Upper Neocomian age, despite the persistent Indian belief (see Wadia 1953) that the Rajmahal Formation is Lower or Middle Jurassic in age. Within Australia *Taeniopteris spatulata* and *Cladophlebis australis* are particularly common in the Jurassic ('Walloon') and Lower Cretaceous (Blythesdale) floras of the Queensland portion of the Great Artesian Basin. Whitehouse (1955, p. 10) notes that the abundance of these two species 'is purely a facies flora; and that when other facies occur, a richer flora, even with *Thinnfeldia*, appears'. Whitehouse (loc. cit.) further quotes that, since *Thinnfeldia* and *Taeniopteris spatulata* range extensively within the Mesozoic, it is erroneous to assume that Australian '*Thinnfeldia* floras are Triassic and those with *Taeniopteris spatulata* are Jurassic, and Lower Cretaceous'. Thus, from the available evidence the Victorian megafloras may be Triassic, Jurassic, or Lower Cretaceous in age, although correlation with the Indian Rajmahal Formation suggests a Lower Cretaceous age.

Two small floras, believed to be younger than those of the Victorian 'Lower Jurassic', were described by Medwell (1954b) from the Merino Group. One, which was collected from upper horizons of the Mocamboro Member, contains an abundance of *Phyllopteroides dentatus* Medwell together with *Taeniopteris spatula* and *Sphenopteris* sp., and was estimated to be of a probable Upper Jurassic age. The other megaflora is from the Runnymede Formation and comprises *Phyllopteroides lanceolata* (Walkom), *Sphenopteris* cf. *S. burrumensis* Walkom, *Phoenicopsis elongatus* (Morris), *Araucarites cutchensis* Feistmantel, and two probable angiospermous leaves. Several of these species occur in the Queensland Lower Cretaceous Burrum flora, and Medwell suggested a similar age for the Runnymede flora.

The only megaplants that have been described (Glaessner and Rao 1955) from the South Australian portion of the Great Artesian Basin were collected from equivalents of the Blythesdale Group near Mt Babbage in the Flinders Ranges. On stratigraphical grounds (Woodard 1955), the flora is no younger than Aptian, and it was assigned to the Neocomian-Aptian on the basis of the following species: *Cladophlebis australis, Taeniopteris spatulata, Otozamites bengalensis* (Oldham & Morris), *Cycadites* sp., *Nilsonnia schaumburgensis* (Dunker), and *Elatocladus planus* (Feistmantel).

Specimens similar to one of the Blythesdale species, *Otozamites bengalensis*, have recently been recorded (Douglas 1962) from basal beds of the Tyers Group in Victoria.

Previous Investigations of Australian Upper Mesozoic Microfloras and Microplankton Assemblages

The first record of spores and pollen contained in Australian Upper Mesozoic sediments was made by Edwards, Baker, and Knight (1944) who illustrated and commented briefly upon several types present in coals from Wonthaggi, Victoria. De Jersey (1951, 1955) presented similar accounts of spores contained in the Burrum and Styx Coal Measures of Queensland, and Cookson (1953) described seven spore and pollen species from a boring at Comaum, South Australia. Cookson (1954) subsequently discussed the stratigraphical and geographical distribution of two of these species.

Balme (1956) recorded a Lower Cretaceous spore assemblage from the Donnybrook Sandstone in the Perth Basin, and subsequently (1957) presented an important contribution to our knowledge of Australian Mesozoic microfloras. All of the spores and pollen described in the 1957 paper were recovered from various localities in the Canning, Carnarvon, and Perth Basins. On a quantitative and qualitative basis Balme delineated three distinct microfloras indicative respectively of Lower Jurassic, Oxfordian-Kimeridgian, and Neocomian-Aptian ages. The successful application of these to correlative problems of Mesozoic sediments in Western Australia is an important outcome of Balme's investigations.

Balme's paper was quickly followed by a series of papers (Cookson and Dettmann 1958a, b; 1959a, b, c; 1961: Cookson 1961: Dettmann 1959) incorporating early results of palynological investigations of eastern Australian and Papuan Upper Mesozoic strata. These papers dealt chiefly with the description of both mega- and microspore species and included some preliminary stratigraphical findings. The majority of the samples investigated were collected from the Great Artesian and Otway Basins and E. Victoria, and all yielded microfloras which suggested a Cretaceous age. Further evidence for this age and the resemblance of the SE. Australian microfloras with those recorded from other parts of the world will be amplified subsequently.

Cookson and Balme have described recently (1962) pollen tetrads from Lower and early Upper Cretaceous strata in the Perth and Otway Basins.

Microplankton in Australian and Papuan Cretaceous strata were first reported by Deflandre and Cookson (1954) and Baker and Cookson (1955) and described by Deflandre and Cookson (1955) and Cookson (1956). Although only a few Cretaceous samples from remote localities were examined, these authors demonstrated the usefulness of microplankton in the inter- and extra-Australasian correlation of Mesozoic sediments. Cookson and Eisenack (1958) reaffirmed this in a substantial paper which deals with microplankton assemblages contained in Upper Jurassic and Cretaceous strata from Australia and Papua. Within several precisely dated bore sequences in the Carnarvon Basin and Papua, two Upper Jurassic, three Lower Cretaceous, and one Upper Cretaceous assemblages were recognized. Similar assemblages were recorded from less precisely dated deposits in the Canning, Perth, Great Artesian, and Styx River Basins, and the strata were tentatively correlated with the dated bore sequences.

The later publications of Cookson and Eisenack (1960a, b; 1961; 1962) and Eisenack and Cookson (1960) incorporate results of further investigations of Australasian Upper Jurassic and Cretaceous deposits. These studies have given a broad overall picture, as comprehensive as sampling permits, of the microplankton sequence in Australasian Upper Mesozoic strata (Oxfordian to Senonian). Correlation of the microplankton assemblages with microfloral assemblages (of Balme 1957; Cookson and Dettmann 1958b; present study) is not yet possible since no well-documented sequence has been investigated for both types of microfossils.

A recent paper by Douglas (1961a) deals with the description of Deflandreidae types present in marine Upper Cretaceous strata of western Victoria.

Methods of Study

The samples examined comprise a wide variety of lithological types, ranging from coals to fine-grained sandstones, and include continental, transitional, and marine sediments. Plant microfossils have been obtained from all lithological types, but, in general, the siltstones yielded the best preserved and most diverse spore assemblages. The plant material was extracted by one of two preparation techniques according to the lithological type (coals or clastics) at hand.

CLASTICS

Clastic samples were given a treatment involving the use of hydrofluoric acid, hydrochloric acid, Schulze solution (concentrated nitric acid and potassium chlorate), followed in some instances by weak alkali. An outline of the process is as follows:

1. Two to three grams of material were broken to a grain size of *c.* 5 mm and transferred to a polythene beaker.
2. Calcareous samples were treated with dilute (*c.* 20%) HCl for a period of 2 hours and subsequently washed several times in distilled water.
3. All samples were then allowed to stand for a period of 1-2 days in cold, 50-60% HF. After this time the acid was decanted and the residue transferred to a nickel crucible to which fresh HF was added and boiled for 30-45 minutes. The HF was removed and the residue washed several times in distilled water.
4. A subsequent treatment with warm, but not boiling, 50% HCl was carried out in order to dissolve the fluorides resulting from the HF treatment.
5. The washed residues, to which a few drops of non-ionic detergent together with *c.* 5 cc distilled water had been added, were subjected to a 5-8 seconds' treatment with an ultrasonic disintegrator (1 : 1 end ratio steel probe vibrating at 20 kilocycles per second). This treatment was most effective in disaggregating clumps consisting of spores and other organic and mineralogical matter, the fine particles of which were disseminated into solution. After disintegration the residues were rinsed and short-centrifuged several times until the top liquor remained clear.
6. Each of the samples was macerated in *c.* 15 cc of Schulze solution. The time for oxidation of individual samples was variable, ranging from 30 minutes to 8 hours. In general, it was found that oxidation was sufficiently advanced when the top liquor was deep chocolate-brown in colour. After maceration the residues were washed several times in distilled water.
7. Only the residues in which the spores were insufficiently concentrated were treated with 10 cc. of dilute ($\frac{1}{2}$-1%) NH_4OH or NaOH. Following addition of alkali, the residues were stirred, immediately centrifuged, and washed repeatedly with distilled water until the top liquor was clear. Treatment with more concentrated alkali solutions was found to result in disorganization or total destruction of spore exines.

COALS

Coals were subjected to the following treatment:

1. Approximately 1 gm of material, crushed to a grain size of *c.* 1 mm, was macerated in 25 cc of Schulze solution. Maceration time, which was longer than that required for clastic samples, ranged from 12 to 14 hours.
2. After removal of the acid solution and several rinses in distilled water, 25-30 cc of 2% NaOH were added to the material. In some instances a further treatment with 4-5% NaOH was necessary to thoroughly dissolve oxidized material, but excessive treatment with alkali usually caused damaged to the spores. Following alkali treatment the residues were rinsed repeatedly in distilled water.
3. Residues containing mineral matter were allowed to stand overnight in 50-60% HF.

The ultimate residues obtained by these methods were transferred for storage to plastic-stoppered glass vials containing 50 % glycerine and a few drops of phenol. Portions of each residue were mounted in either unstained or lightly stained (with safranin O) glycerine jelly on standard glass microscope slides. Two to four strew-slides were prepared from each residue and in addition several hundred spores were mounted singly. Cover slips (no. 0) were sealed with gold size at least 3 days after mounting.

From one to several representatives of 28 spore species were serial sectioned following the embedding and sectioning techniques of Wigglesworth (1959). A full outline of these procedures, in which the spores are double-embedded in agar and ester wax before sectioning, is given by Hughes, Dettmann, and Playford (1962, p. 247-48; Fig. 1). All spores that have been sectioned were obtained from preparations treated with Schulze solution and dilute alkali as follows:

Preparation No.	Section No.	Maceration period (hours)	Alkali solution
D139	S72b, c	12	4% NaOH
D217	S57-S60 incl.	8	1% NaOH
D226	S70, S73	2	< 1% NaOH
D247	S55, S56	½	< 1% NH_4OH
D272	S84, S85	3	< 1% NH_4OH
D286	S61, S62	8	< 1% NH_4OH
D289	S63-S69 incl.	1	1% NH_4OH
D302	S76-S82 incl.	2	1% NH_4OH

The sections were cut at 2-3 μ intervals transverse to the equatorial plane and are mounted in unstained glycerine jelly under cover slips sealed with gold size.

Strew-slides were first surveyed at a magnification of × 100, and all morphological analyses and identifications of species present were determined at magnifications of × 400 and × 1,000. After all productive samples had been examined the constituent spore species were described; the systematic descriptions set out below incorporate the morphological features observed in well-preserved and, in certain cases, corroded and sectioned specimens.

Quantitative analyses were carried out on all core and cutting samples, which yielded sufficiently well-preserved microfloras, from the reference successions in the Great Artesian Basin (Oodnadatta Bore No. 1 and Cootabarlow Bore No. 2) and Otway Basin (Penola Bore No. 1 and Robe Bore No. 1). The quantitative estimations were derived after 250 specimens from each sample had been counted under high power and the resulting percentages represent the relative abundance of each species in the individual samples.

Systematic Section

NOMENCLATURE AND CLASSIFICATION

Nomenclature of the fossil spores (unless otherwise indicated, the term is used here in the comprehensive sense and denotes spores *s. str.* and pollen) described in the present study is based upon the rules of priority and typification as laid down in the International Code of Botanical Nomenclature (1961, Montreal). The binomial designation is used for all formally named species, and the genera to which the species are referred are here regarded as artificial (form) taxa since they are based on morphological features of detached spores. The form genera and species are classed within suprageneric categories of an artificial classification; nomenclature of these suprageneric taxa does not come within the jurisdiction of the International Code of Botanical Nomenclature (see Art. 3). Natural botanical affinities, where known, are documented within the artificial categories of the system.

Although the majority of systematic palynologists working on pre-Quaternary material now adhere to the rules of typification and priority, considerable nomenclature confusion exists in spore taxonomy. This is not unexpected as a consequence of a rapidly evolving science, but much of the current nomenclatural chaos may have been avoided if the names of natural genera had not been applied in the binomial designations of artificial spore species. Certainly there appears to be no justification for the assignment (or identification) of fossil dispersed spores to natural plant genera on the basis of spore morphology alone. Many such identifications, when published, not only add to the prevailing nomenclatural confusion, but, as noted by Pierce (1961, p. 12), may also be a 'source of misinformation'.

As opposed to nomenclature, there are no established rules for the classification of dispersed-spore taxa. A variety of artificial classification schemes has been presented to date, including those by authors from Russia (Naumova 1939; Maljavikina 1949), Europe (Erdtman 1947; Erdtman and Straka 1961; Potonié and Kremp 1954, 1955, 1956, and Potonié 1956, 1958, 1960; Krutzsch 1959), England (Raistrick 1934), the Americas (Schopf, Wilson, and Bentall 1944; Rouse 1957; van der Hammen 1956a), and India (Pant 1954). However, because the frameworks of the majority of these systems lack uniformity and a means by which all spores can be methodically classified into automatically delineable units, only a few have received widespread use. Three of the most comprehensive, readily applied methods that have been formulated for the classification of dispersed spores are briefly outlined below.

The classification scheme presented by Naumova (1939, p. 354) 'is based, in the first place, on the mode of germination, and secondly, on the nature of the sculpture of the exine (Fig. 1)'. It should be noted that within her group Sporae, which includes spores (*s. str.*), Naumova also used the presence or absence of a 'margin' (p. 355) as a classificatory feature. Thus, the spore 'genera' recognized by Naumova are included within the following 'suprageneric' categories: Azonotriletes and Zonotriletes which comprise Triletes; Azonomonoletes and Zonomonletes of Monoletes; and Aletes. The classes recognized within her Pollina, which includes pollen, were established on the basis of the presence or absence of an aperture, type of aperture, and finally type of exinal sculpture. The scheme, which is fully outlined on Naumova's Fig. 1, is a readily applicable key, since only one diagnostic feature is used for subdivision of the groups at any one taxonomic level. The system was adopted by the majority of Russian authors concerned with Palaeozoic dispersed-spore studies (Naumova 1953, Ishchenko 1952, and others), and it was modified slightly by Maljavikina (1949) for the classification of Mesozoic spores. However, in recent years Naumova's 'generic' groups, some of which still lack type designation, have become considerably overloaded, and their circumscriptions have been broadened such that the taxa are no longer useful working units. Further, many Russian authors of Mesozoic and Tertiary spore species use the natural classification in preference to Naumova's scheme.

Van der Hammen's (1956a) key is also based on aperture and sculptural features and is provided with a built-in nomenclatural system. According to this system, the names of the generic categories incorporate the descriptive terms (of Iversen and Troels-Smith 1950) that are used to designate the diagnostic morphological features. Correct names of validly instituted, pre-existing genera assignable to the system were ignored by van der Hammen. Following these principles van der Hammen (1956a, 1956b) and Pierce (1961) applied the key for the codification of certain Upper Mesozoic and Tertiary dispersed-spore species, but no attempt has yet been made to allocate Palaeozoic forms to the system. As at present outlined the generic groups of Sporites, which includes spores (*s. str.*), incorporate diverse morphological forms since azonate and zonate forms are not necessarily segregated at generic level. The most serious defect of the scheme is that its nomenclature cannot be reconciled with the established principles laid down in the International Code of Botanical Nomenclature.

The morphological system instituted by Potonié and Kremp (1954) and subsequently amplified by these authors (1955, 1956) and Potonié (1956, 1958, 1960) is, in the writer's opinion, the most comprehensive and satisfactory classification scheme presented to date. The scheme is based on the larger majority of morphological forms described before and up to the late 1950's, and Potonié and Kremp seriously attempted to adopt only those names (of taxa of generic and lower rank) that comply with the rules of typification and priority. The genera are orderly grouped into artificial suprageneric categories of infraturma, subturma, turma, and anteturma rank, and the diagnostic features of each of the suprageneric categories are clearly specified. The features upon which the suprageneric taxa are based include aperture, wall stratification, thickening and/or extension of the exine, and exine sculpture. Certain of the categories delineated broadly correspond to the subdivisions of the schemes proposed by Naumova, van der Hammen, Pant (1954),

TABLE 1

Schematic outline of system instituted by Potonié and Kremp (1954) for classification of Sporites.

<table>
<tr><td>Diagnostic features</td><td colspan="18">Category</td><td>Rank</td></tr>
<tr><td></td><td colspan="18">SPORITES</td><td>Anteturma</td></tr>
<tr><td>aperture
lip features
equatorial features</td><td colspan="7">TRILETES</td><td>BARBATES</td><td colspan="5">ZONALES</td><td colspan="4">MONOLETES</td><td>CYSTITES</td><td>Turma</td></tr>
<tr><td>lip features
stratification
equatorial features</td><td colspan="3">AZONOTRILETES</td><td>LAGENOTRILETES</td><td rowspan="2">PYROBOLOTRILETES</td><td rowspan="2">CAPULITRILETES</td><td rowspan="2">PERINOTRILITES</td><td rowspan="2"></td><td colspan="2">AURITOTRILETES</td><td colspan="3">ZONOTRILETES</td><td colspan="3">AZONOMONOLETES</td><td rowspan="2">ZONOMONOLETES</td><td rowspan="2"></td><td>Subturma</td></tr>
<tr><td>lip features
sculpture
equatorial features</td><td>LAEVIGATI</td><td>APICULATI</td><td>MURORNATI</td><td>GULATI</td><td>AURICULATI</td><td>APPENDICIFERI</td><td>CINGULATI</td><td>ZONATI</td><td>PATINATI</td><td>LAEVIGATOMONOLETI</td><td>SCULPTATOMONOLETI</td><td>PERINOMONOLITI</td><td>Infraturma</td></tr>
</table>

and others. However, Potonié and Kremp were effectively the first to recognize the diagnostic value of wall stratification for the classification of fossil dispersed spores.

Because the morphological system presented by Potonié and Kremp represents a comprehensive, readily applied method for the classification of dispersed spores, it has found widespread acceptance among palynologists. Some authors, however, have found that the scheme contains certain inconsistencies in that spores of identical morphology can be grouped into more than one suprageneric category. These inconsistencies have resulted from the arbitrary and inconsistent use of more than one diagnostic criterion for the subdivision of the various suprageneric taxa.

TABLE 2

Outline of revised system for classification of Sporites.

Diagnostic feature	Category													Rank
	SPORITES													Anteturma
aperture	TRILETES								MONOLETES				HILATES	Turma
stratification	ACAVATITRILETES							PERINOTRILITES	ACAVATOMONOLETES			PERINOMONOLITES		Suprasubturma
equatorial features	AZONOTRILETES			ZONOTRILETES					AZONOMONOLETES		ZONOMONOLETES			Subturma
sculpture / equatorial thickening and/or extension	LAEVIGATI	APICULATI	MURORNATI	AURICULATI	TRICRASSATI	CINGULATI	PATINATI		LAEVIGATOMONOLETI	SCULPTATOMONOLETI				Infraturma

Consideration is given here only to the classification of spores grouped within the Anteturma Sporites H. Potonié. This group, as it is classified by Potonié and Kremp, is schematically outlined in Table 1. From this outline it will be seen that Sporites is subdivided into turma units on the basis of the inconsistent use of three diagnostic features, viz. aperture, lip, and equatorial features. Of the five turma units delineated by Potonié and Kremp, three at least are trilete (Triletes Reinsch, Zonales Bennie and Kidston, and Barbates Mädler), and the circumscriptions of the trilete categories are mutually overlapping: Barbates includes spores assignable also to both Triletes and Zonales, and Triletes incorporates lipped spores which conform with Barbates. Triletes is further subdivided on the basis of two diagnostic features, lip modification and wall stratification, and its five subturma taxa are not clearly distinguishable from one another: Perinotrilites Erdtman includes azonate or zonate trilete spores with a stratified, cavate wall; Azonotriletes Luber incorporates azonate, trilete forms which may be lipped and which may have a stratified cavate wall; and all of Capulitriletes Potonié, Pyrobolotriletes Potonié, and Lagenotriletes Potonié and Kremp are trilete megaspore units which conform also to Barbates and which are characterized by lip development. From this outline it is apparent that many of the suprageneric taxa, as diagnosed by Potonié and Kremp, are mutually overlapping.

For effective, orderly codification of dispersed spores, the system used must be composed of mutually exclusive taxonomic units, which, at any particular rank, are based on one diagnostic character only (see Erdtman and Straka 1961, Pierce 1961). This principle has been applied by the present writer for classifying the spores of Sporites. An outline of the scheme, thus formulated, is given in Table 2. It is based upon firstly, aperture characters; secondly, wall stratification; thirdly, equatorial thickening and/or extension of the wall; and finally, sculptural features. Further explanations of the scheme together with diagnoses of the various suprageneric taxa are given in the following pages. The diagnostic features of the taxa are designated by means of the descriptive terminology set out below.

GLOSSARY OF DESCRIPTIVE TERMS

The descriptive terms used in the systematic section below are mainly those which have been widely accepted and used in the same sense by previous authors. The terms employed are listed and defined under headings of the basic features which they describe: shape and polarity; the spore wall, its stratification, construction, sculpture, and structure. Many of the definitions have been extracted with little or no modification from the comprehensive glossaries given by Potonié (1934), Erdtman (1952), Harris, W. F. (1955), and Potonié and Kremp (1955), and reference is made to the authors of the definitions. Where the circumscription of a term has been revised by the present writer reference to the originator of the term is placed in brackets.

Polarity and Shape

Amb—Erdtman 1952, p. 459; the outline of a spore viewed from the direction of the polar axis.

Contact Face—Harris, W. F. 1955, p. 25: the area adjacent to the tetrad mark.

Dimensions—see Fig. 3. Unless otherwise specified the dimensions given in the systematic descriptions are based on at least 30 specimens; the bracketed figure is the mode.

Distal Pole—Erdtman 1952, p. 467: the point opposite the proximal pole.

Distal Surface—Erdtman 1952, p. 462: that part of the spore which is directed outwards in its tetrad.

Equator—Erdtman 1952, p. 467: the border line between the proximal and distal surfaces of a polar spore.

Equatorial Axis—Potonié and Kremp 1955, p. 10: any axis in the equatorial plane which intersects the polar axis.

Interradial Region: the region that includes the proximal area adjacent to the tetrad mark and the corresponding distal area (see Fig. 3a).

Krytome—Klaus 1960, Fig. 2: an abruptly convex exinal area in the proximal and equatorial radial regions; the limits of this area more or less parallel the tetrad mark (see Fig. 3b). In compressed spores the kyrtomes usually are reduced to arcuate folds which surround the laesurae.

Polar Axis—Erdtman 1952, p. 467: a line connecting the poles of a spore.

Polar Outline: the outline of the spore as seen in equatorial view (= profile of Harris, W. F. 1955, p. 26).

Proximal Surface—Erdtman 1952, p. 467: that part of the spore which is directed inwards in its tetrad.

Radial Region: the region comprising the proximal area in the immediate vicinity of the tetrad mark and the corresponding distal area (see Fig. 3a).

Tetrad Mark: the mark on that part of the proximal surface which was in contact with the other spores of the tetrad. In trilete and monolete spores the tetrad mark corresponds in position to the laesurae.

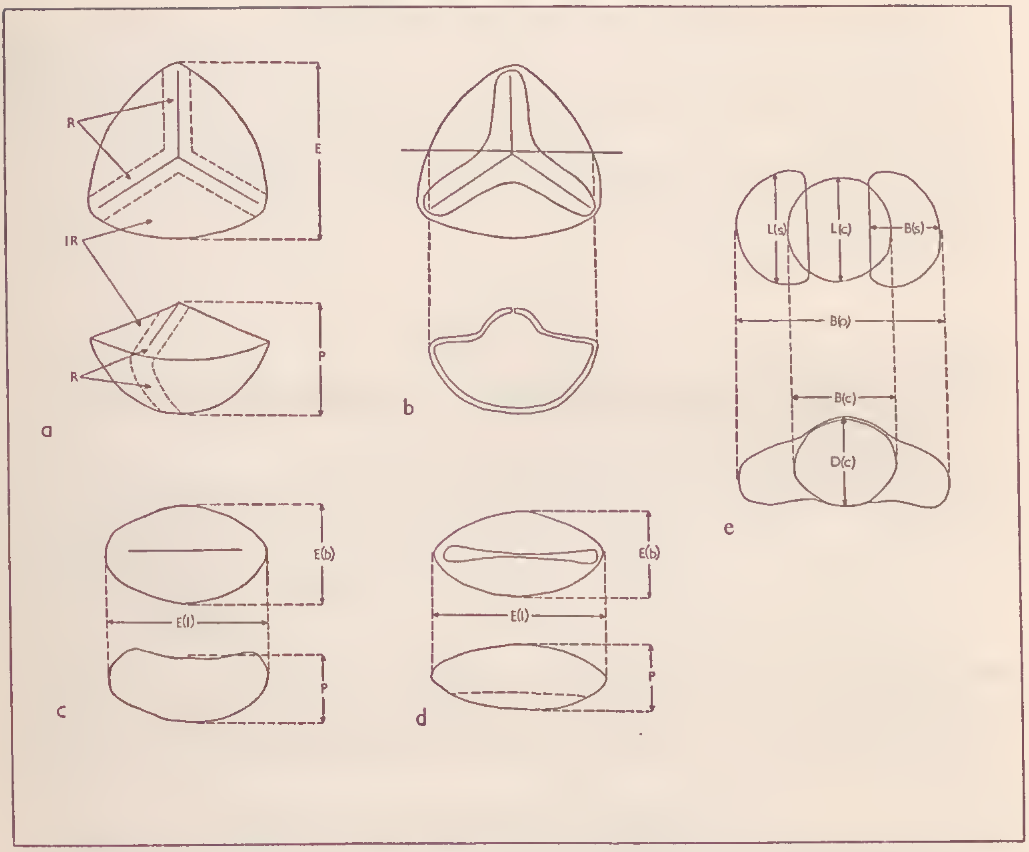

FIG. 3—(a) Showing dimensions measured on, and interradial and radial regions of, trilete spores; (b) Surface and sectional views of a trilete spore possessing kyrtomes; (c-e) Showing dimensions measured on monolete spores and tenuate and bisaccate grains.

R = radial regions; IR = interradial regions; E = equatorial diameter; E(b) = equatorial diameter (breadth); E(l) = equatorial diameter (length); P = polar diameter; B(o) = overall breadth; B(c) = corpus breadth; B(s) = saccus breadth; L(c) = corpus length; L(s) = saccus length; D(c) = corpus depth.

THE SPORE WALL (SPORODERM)

(A) Stratification

EXINE—Erdtman 1952, p. 463: the main, outer, usually resistant layer of a sporoderm. Unless otherwise stated the measurements given in the systematic descriptions for the thickness of the exine were taken from optical or transverse sections and do not include the height of the sculptural elevations, if present.

EXOEXINE—Potonié and Kremp 1955, p. 17: the outer, sculptured layer of the exine. Where this layer is stratified, the terms OUTER EXOEXINE and INNER EXOEXINE may be applied to the outer and inner layers respectively (see Hughes 1955, p. 207).

INTEXINE—Potonié and Kremp 1955, p. 17: the inner, non-sulptured layer of the exine.

PERINE—Erdtman 1952, p. 466: the outermost, extraexinal, sporoderm layer in some spores. This layer is thought 'to be due to the activity of a periplasmodium' (Erdtman loc. cit., see also Harris, W. F. 1955, pp. 16-17) and is difficult to distinguish even in recent spores. Harris (loc. cit.) and others have demonstrated that in some plant species the perine is developed at a late stage in spore maturation (after or during separation of the spore-mother-cell), and that both mature, perinate and immature, aperinate spores may be shed from the same sporangium. These observations have led Harris (loc. cit.) to state 'One cannot be sure, apparently, of the correct application of such terms as ektexine' (exoexine) 'and perine without reference to the ontogeny of the spore, which, in the case of fossil spores would not be known'. For these reasons the term perine has not been used by the present writer; in the cases where the term may have been applicable the alternative phrase OUTER LAYER OF SCULPTINE (see Erdtman 1952, p. 18) is used.

SCLERINE—Erdtman 1952, p. 468: sporoderm except for intine. In aperinate spores the sclerine corresponds to the exine.

SCULPTINE—Erdtman 1952, p. 468; sclerine except for intexine. In aperinate spores the sculptine corresponds to the exoexine.

(B) Construction

(1) Apertures

LAESURA—Erdtman 1952, p. 12: the proximal APERTURE of trilete and monolete spores. Trilete spores possess three laesurae which radiate from the proximal pole, and monolete spores possess one laesura which has its centre at the proximal pole. (Note laesura sensu Erdtman = commissure of Harris 1955, p. 25).

HILUM—(Erdtman 1952, p. 12): the usually irregular, distal or proximal APERTURE of certain spores. The hilum forms as the result of a natural breakdown of the sclerine in an area showing structural and/or sculptural modification about the distal or proximal pole. E.g. *Aequitriradites* (Pl. XXII,, fig. 1-15; Pl. XXIII, fig. 1-3) and *Cooksonites* (Pl. XXI, fig. 8-11) exhibit a distal hilum; *Couperisporites* (Pl. XXI, fig. 12-19) is characterized by a proximal hilum. This type of aperture is found also in spores of certain living and fossil hepatic species. e.g. in the living *Geothallus tuberosus* Campbell (see Erdtman 1957, Fig. 26) and the fossil *Naiadita lanceolata* Buckman (sec Harris, T. M. 1938, Fig. 21, 22; present study, Pl. XXVII, fig. 9-11).

TENUITAS—Erdtman 1952, p. 471; thin, more or less aperturoid exine area, not as distinctly delimited as true apertures. The term is here applied to the distal aperturoid area of certain bisaccate and monosulcate (sensu Couper 1958, p. 103) gymnospermous grains, e.g. *Alisporites similis* (Pl. XXV, fig. 5-7) and *Ginkgocycadophytus nitidus* (Pl. XXVI, fig. 8, 9).

(2) Thickenings and Extensions of the Spore Wall

AURICULAE—(Potonié and Kremp 1955, p. 15): radially situated extensions of the equatorial exine (or exoexine). E.g. *Tripartites* Schemel.

CAVATE—Dettmann 1961, p. 72: asaccate spores in which the wall layers are partially or almost completely separated from each other by a cavity. E.g. in *Crybelosporites stylosus* (Pl. XVIII, fig. 12-20) the outer layer of the sculptine is proximally separated from the inner layers by a cavity, whilst in *Densoisporites velatus* (Pl. XIX, fig. 4-8) the wall layers are distally and equatorially separated from each other by a cavity. The term also is applied here to denote the hollow condition of sculptural elevations and exinal thickenings and/or extensions, e.g. the cingulum and muri of *Contignisporites glebulentus* (Pl. XV, fig. 1-10).

CINGULUM—(Potonié and Kremp 1955, p. 12): a comprehensive thickening of the equatorial exine (or exoexine). As seen in transverse section the cingulum may taper sharply (*Cirratriradites elegans*; Hughes et al. 1962, Pl. 38, fig. 6, 7) or only slightly (*Murospora florida*; Pl. XIV, fig. 13, 14). Spores exhibiting a sharply tapering cingulum are often termed 'cingulizonate'.

CORONA—(Potonié 1956, p. 54): extensions of the equatorial exine (or exoexine) in the interradial regions. The extensions may be dissected and composed of fimbriate-like elements, e.g. in *Reinschospora* Schopf, Wilson, and Bentall.

LIMBUS: the term was used by Potonié and Kremp (1955, p. 19) to denote an equatorial thickening of the outer wall layer in cavate (monosaccate sensu Potonié and Kremp) spores. The term is replaced here by cingulum.

LIPS—(Potonié and Kremp 1955, p. 11): thickening and/or upturned extensions of the exine (or exoexine) about the laesurate margins (= margo of Harris, W. F. 1955, p. 26 and Couper 1958, p. 103). E.g. in *Biretisporites spectabilis* (Pl. II, fig. 3-8) the lips are narrow, elevated extensions of the proximal exine, and in *Klukisporites scaberis* (Pl. VIII, fig. 1-7) the lips are sculptured thickenings of the exine. The type of lips, and their height and width should always be denoted.

INTERRADIAL CRASSITUDES: thickenings of the equatorial exine (or exoexine) in the interradial regions. E.g. *Coronatispora perforata* (Pl. XIII, fig. 17-20).

POLAR CRASSITUDE: distal, polar, exinal (or exoexinal) thickening as in *Coronatispora perforata* (Pl. XIII, fig. 17-23). Compare patina of Butterworth and Williams (1958, p. 381) and patella and capsula of Staplin (1960, p. 28-29), which, however, are exinal thickenings that are developed over the entire distal hemisphere.

SACCUS—Erdtman 1952, p. 468: more or less equatorially situated air sac (exoexine loosened from intexine; baculoid elements usually sticking to the under surface of the exoexine). Mono-, bi-, and poly-saccate forms are described herein; these are distinguishable from trilete, cavate forms in having baculoid rods and a distal tenuitas and in lacking a proximal aperture.

VALVAE—Potonié and Kremp 1955, p. 15: thickenings of the equatorial exine (or exoexine) in the radial regions. E.g. *Matonisporites cooksoni* (Pl. XI, fig. 1-8).

VESICULAE—Harris W. F. 1955, p. 27: small air sacs. The term is used herein to denote small, hollow, more or less polar protuberances of saccate forms, e.g. *Tsugaepollenites trilobatus* (Pl. XXIV, fig. 6-10).

ZONA—(Potonié and Kremp 1955, p. 15): a comprehensive extension of the equatorial exine (or exoexine). E.g. *Kraeuselisporites linearis* (Pl. XVII, fig. 1-4).

(3) Sculpture

BACULA—Potonié 1934, p. 11: straight-sided flat-topped elevations.

CAPILLI—Potonié and Kremp 1955, p. 14: projections in which the terminations are branched; column straight-sided or constricted; height greater than basal diameter.

CLAVAE—Harris, W. F. 1955, p. 19: projections in which the terminations are constricted; height greater than basal diameter.

FOVEOLAE—Erdtman 1952, p. 463: small (up to 2 μ) depressions which are more or less rounded in surface view.

GRANULA—Erdtman 1952, p. 463: small (up to 1 μ) more or less isodiametric elevations.

LUMINA—(Potonié 1934, p. 11): the spaces between the muri or rugulae in murornate spores; the muri may not necessarily be coalescent.

MURI—(Potonié 1934, p. 11): elevations which are elongated and straight-sided in basal outline (greatest basal diameter at least twice minimum basal diameter); sides parallel, converging, or diverging; crests flat, rounded, or pointed.

RUGULAE—Harris, W. F. 1955, p. 20: elevations which are elongated and irregular in basal outline (maximum basal diameter at least twice minimum basal diameter); sides parallel, converging, or diverging; crests flat, rounded, or pointed.

SETULAE—Harris, W. F. 1955, p. 19: straight-sided projections in which the terminations are bluntly tapered.

SPINAE—cf. Erdtman 1952, p. 469: elevations in which the height is at least twice the basal diameter; apices pointed.

SPINULAE—cf. Erdtman 1952, p. 469: elevations in which the height is less than twice the basal diameter; apices pointed.

VERRUCAE—Potonié 1934, p. 11: elevations in which the bases are more or less isodiametric and greater than 1 μ diameter.

(4) Structure

STRUCTURE—Faegri and Iversen 1950, p. 18: the form and arrangement of the individual elements within the sclerine.

GRANULATE STRUCTURE: the term is used herein to describe the structure of a wall layer that is composed of granules.

HOMOGENEOUS STRUCTURE: when no individual structural components are discernible, the wall is described as homogeneous.

SPONGEOUS STRUCTURE: the structure of a wall layer that is composed of loosely-packed components.

NOTE ON DESCRIPTIVE PROCEDURE AND DESIGNATION OF TYPES

Unless otherwise indicated the dimensions (see Glossary of Descriptive Terms; Fig. 3) given in the systematic descriptions were derived from at least 30 suitably orientated specimens. All new species are based on at least 8 adequately preserved specimens. The holotypes together with at least one other representative of each new species, and one to several specimens of all previously described microspore species are illustrated by means of photographs; in addition some drawings, which have been drawn from photographs, are provided. Microtome sections of 28 of the species represented in the Australian material are illustrated. Holotypes are annotated as to their orientation in the microscope field, and the focus (or foci) depicted for all illustrated specimens is noted.

Australian Upper Mesozoic spore species are depicted on Plates I to XXVI inclusive and Fig. 4 to 6 inclusive. They are referred to by the preparation (prefixed 'D' or 'ICC')/section (prefixed 'S'), if applicable/slide number, followed by the 'E.-W.' and 'N.-S.' microscope vernier readings and the registered numbers (prefixed 'P') of the palaeontological collection of the National Museum of Victoria. The vernier readings are from Leitz Laborlux microscope No. 1 of the Sedgwick Museum, Cambridge: a master slide, with two reference points clearly marked and located by means of Leitz Laborlux No. 1 readings, has been deposited with the collection in the National Museum of Victoria; the registered number of this slide is P22604.

Type and other specimens of species described originally by Couper (1958) and Cookson (1947) are figured on Plate XXVII. Plate XXVII also incorporates illustrations of spores of two recent and one fossil hepatic species; these spores are described in Appendix I.

Systematic Descriptions

ANTETURMA SPORITES H. Potonié 1893

Spores attributable to this category possess one of the following aperture features:

(a) three proximal laesurae which radiate from the pole
(b) one proximal laesura which has its centre at the pole
(c) a distal or proximal polar, usually irregular hilum which forms as the result of a natural breakdown of the sclerine in an area showing structural and/or sculptural modification. Spores exhibiting this feature usually are further characterized by a proximal tetrad mark comprising three radial ridges.

REMARKS: The spores comprising Sporites H. Potonié are allocated to one of the three mutually exclusive taxonomic groups of turma rank on the basis of one spore feature alone, viz. the character of the aperture. Trilete spores are referred to Triletes Reinsch, monolete spores to Monoletes Ibrahim, and hilate spores to Hilates turma nov.

The alternative scheme (see Table 1) proposed by Potonié and Kremp (1954, 1955, 1956) and Potonié (1956, 1958, 1960) for grouping the spores of Sporites into turma units is dependent upon the inconsistent use of one to several spore features. Three, and possibly four, of the five turma units proposed by these authors include trilete spores, and the circumscriptions of these trilete categories are mutually overlapping such that spores of identical morphology may be allotted to two or more turmas. E.g. *Pyrobolospora* Hughes which is characterized by a trilete aperture enclosed within elevated, laesurate lips conforms with both Triletes and Barbates Mädler, and *Thomsonia* Mädler which possesses equatorial extensions (auriculae) and elevated laesurate lips surrounding the trilete aperture is attributable to either Zonales Bennie and Kidston or Barbates.

TURMA TRILETES Reinsch emend.

Triletes as used here incorporates spores having a proximal trilete aperture. The trilete aperture may be simple or lipped, the lips constituting thickened and/or upturned extensions of the proximal sclerine. In certain genera the lips are highly specialized proximal exinal extensions (e.g. *Pyrobolospora* and *Nathorstisporites* Jung) which may be fused to form a gula over the proximal pole (as in *Lagenicula* Bennie and Kidston ex Potonié and Kremp). It should be noted that a large number of the trilete forms show radial symmetry (symmetrical about the three laesurae).

REMARKS: Spores previously allocated by Potonié and Kremp (1954 and later) and Potonié (1956 and later) to the turma categories, Triletes, Zonales, and Barbates, and possibly those of Cystites Potonié and Kremp, are characterized by a trilete aperture and conform with Triletes as emended above.

It is recognized that the name of this category is the correct name of the genus *Triletes* Reinsch ex Schopf which some authors (see Schopf 1938 and Winslow 1959, and cf. Potonié and Kremp 1954, 1955) consider as validly based. However, the application of the name at generic level does not nullify Potonié and Kremp's (1954 and later) use of the name for a suprageneric category, as the laws of priority and typification only apply to form units of generic or lower rank (see International Code of Botanical Nomenclature 1961, Art. 3, 7).

As outlined in Table 2, trilete spores are here grouped into two suprasubturma categories according to the stratification and nature of the sclerine. Trilete spores characterized by a cavate sclerine (for definition see Glossary of Descriptive Terms) are assigned to Perinotrilites Erdtman, while those which possess an acavate sclerine are allocated to Acavatitriletes s.s. turma nov.

Suprasubturma ACAVATITRILETES s.s. turma nov.

Acavatitriletes is proposed for trilete spores which possess an acavate sclerine. The sclerine may be of uniform or differential thickness, the presence or absence of equatorial thickenings serving as a basis for subdivision of this group (see Table 2).

REMARKS: Acavate spores assigned to the turma units, Zonales and Barbates, and to the subturma categories, Azonotriletes Luber, Lagenotriletes Potonié and Kremp, Pyrobolotriletes Potonié, and Capulitriletes Potonié, of Triletes conform with Acavatitriletes.

Subturma AZONOTRILETES Luber emend.

Azonotriletes Luber is emended to include acavate, trilete spores in which the sclerine is more or less of uniform thickness (distal and equatorial sclerine unthickened). The laesurae may be simple or lipped.

REMARKS: The above emendation broadens the original circumscription of the group which now incorporates the azonate, trilete spores of Azonotriletes Luber sensu Potonié and Kremp (1954 and later) together with the azonate, trilete spores which are conspicuously lipped, of Pyrobolotriletes, Lagenotriletes, Capulitriletes, and Barbates.

As outlined by Potonié and Kremp (loc. cit.) and Potonié (1956 and later) this group is subdivided on the basis of sculptural features.

Infraturma LAEVIGATI Bennie & Kidston emend. Potonié 1956

Azonate, acavate, trilete spores comprising this taxon are characterized by a smooth or almost smooth exine and may have simple or lipped laesurae. Thus the essentially smooth-walled spores of Pyrobolotriletes, Lagenotriletes, and Capulitriletes conform with this infraturma.

Genus **Cyathidites** Couper 1953

TYPE SPECIES: *Cyathidites australis* Couper 1953.

REMARKS AND COMPARISON: Smooth or faintly patterned, trilete microspores having a concavely triangular amb are here attributed to *Cyathidites* Couper since the valid institution of this genus precedes the validation of *Alsophilidites* Cookson ex Potonié, *Cardioangulina* Maljavikina ex Potonié, and *Pyramidella* Maljavikina ex Potonié. *Concavisporites* Pflug, as emended by Delcourt and Sprumont (1955), differs from *Cyathidites* in having proximal kyrtomes (for definition see Glossary of Descriptive Terms). Some of the species assigned below to *Cyathidites* include uncompressed specimens in which the proximal polar exine shows slight differentiation in convexity, but compressed specimens of the same species lack arcuate folds in the proximal, interradial regions. As noted by Delcourt, Dettmann, and Hughes (1963) *Cyathidites* is distinct from *Deltoidospora* Miner which is characterized by a straight-sided triangular amb and *Leiotriletes* Naumova ex Potonié and Kremp which has a convexly triangular amb.

AFFINITY: Couper (1953, 1958) has fully discussed the possible affinity of *Cyathidites* with cyatheaceous and dicksoniaceous ferns; in particular of *C. minor* Couper with *Coniopteris hymenophylloides* (Brongn.), *C. tatungensis* Sze., *Eboracia lobifolia* (Phillips), and *Dicksonia mariopteris* Wilson and Yates. Comparable spores have been described more recently by Harris, T. M. (1961, p. 142-64) in *Coniopteris simplex* (L. & H.), *C. burejensis* (Zalessky), *C. bella* Harris, and *C. murrayana* (Brongn.). However, the closely related species *C. margaretae* Harris and *Dicksonia kendalli* Harris contain spores which are distinct from *Cyathidites* in showing membraneous, elevated, laesurate lips.

Several Russian authors have shown that other species now included within *Cyathidites* are comparable to some of the spores found in *Lygodium* Swartz, and these authors attribute the fossil dispersed spores to this modern genus.

Cyathidites australis Couper 1953

(Pl. I, fig. 1-3)

SELECTED SYNONYMY:

1953 *Cyathidites australis* Couper, p. 27; Pl. 2, fig. 11, 12.
1953 *Lygodiosporites adriennis* Potonié & Gelletich f. *mesozoicus* Thiergart: Cookson, p. 470; Pl. 2, fig. 29.
1956 *Cyathidites mesozoicus* (Thiergart) Potonié (pars), p. 14 (reference to specimen figured by Cookson in 1953).
1961 *Lygodiumsporites adriennis* Potonié & Gelletich: Bolkhovitina, p. 104-105; Pl. 31, fig. 3a (illustration of specimen figured by Cookson in 1953).

DIMENSIONS: Equatorial diameter 50 (59) 73 μ.

DISTRIBUTION: *Cyathidites australis* Couper has been frequently reported from Mesozoic strata and is common throughout the Upper Mesozoic of SE. Australia (see Tables 3-9).

Cyathidites minor Couper 1953

(Pl. I, fig. 4, 5)

SELECTED SYNONYMY:

1953 *Cyathidites minor* Couper, p. 28; Pl. 2, fig. 13.
1953 *Lygodiosporites adriennis* Potonié & Gelletich f. *mesozoicus* Thiergart: Cookson, p. 470; Pl. 2, fig. 30.

1956 *Cyathidites mesozoicus* (Thiergart) Potonié (pars), p. 14 (reference to specimen figured by Cookson in 1953).

1961 *Lygodiumsporites adriennis* Potonié & Gellitich: Bolkhovitina, p. 104-105; Pl. 31, fig. 3b (illustration of specimen figured by Cookson in 1953).

DIMENSIONS: Equatorial diameter 25 (33) 45 μ.

REMARKS: Smooth-walled, trilete microspores attributable to *Cyathidites minor* Couper are of common occurrence in many of the samples examined, particularly in those from eastern Victoria (see Tables 3-9). Their frequent occurrence may be a reflection of the cyatheaceous and dicksoniaceous elements (e.g. *Coniopteris hymenophylloides* (Brongn.) var. *australica* Seward) which are abundantly represented in the Victorian Mesozoic flora (see Medwell 1954a).

The species shows world-wide distribution in Mesozoic sediments. In Australasia it is known from Jurassic and Cretaceous sediments (Couper 1953; Balme 1957).

Cyathidites punctatus (Delcourt & Sprumont) Delcourt, Dettmann, & Hughes 1963

(Pl. I, fig. 6-9)

SYNONYMY: See Delcourt, Dettmann, and Hughes 1963, p. 283.

DESCRIPTION: Microspores trilete, elliptical in lateral view; amb concavely triangular with broadly rounded angles. Laesurae straight, length $\frac{2}{3}$ spore radius; in compressed specimens laesurae accompanied by 'lips' which narrow sharply at equatorial extremities of apertures and which constitute narrow, oblique exposures of the exine at laesurate margins. Exine 2-3 μ thick; with a distinct OL pattern in surface view and low undulations in optical section.

DIMENSIONS: Equatorial diameter 47 (63) 81 μ.

REMARKS AND COMPARISON: Only compressed specimens of the Australian representatives of this species possess 'lips' which are narrow, oblique exposures of the exine adjoining the laesurae (see Van Campo 1961, Fig. 5-8; Delcourt et al. 1963). Spores similar to, if not identical, with *Cyathidites punctatus* have been attributed to *Lygodium punctatituberculatum* Maljavikina, *L. fumatum* Verbitskaya, *L. scrobiculatum* Verbitskaya, *L. concors* Ivanova, and *L. granulatum* Ivanova. Some of these Russian and Siberian species probably include corroded representatives of *Cyathidites punctatus* (Pl. I, fig. 9).

On the other hand, *Cyathidites asper* (Bolkhovitina), to which Bolkhovitina (1961) referred *C. punctatus*, is clearly distinct in having a thicker exine, longer laesurae, and more acutely rounded amb-angles. *Cardioangulina tricancantha* Maljavikina differs from *C. punctatus* in possessing shorter laesurae and a smooth exine.

AFFINITY: On the basis of spore morphology Couper (1958) suggests that *C. punctatus* may have derived from cyatheaceous or dicksoniaceous plants, whereas Bolkhovitina (1961) implies that the species has an affinity with *Lygodium* Swartz.

DISTRIBUTION: The species was described from Wealden strata of Belgium (Delcourt & Sprumont 1955). Subsequent records include Wealden and Aptian of Britain (Couper 1958), Barremian-Aptian of U.S.S.R. (Bolkhovitina 1961), and Berriasian-Aptian of Canada (Pocock 1962). *C. punctatus* is widely distributed in SE. Australia (see Tables 4-9); in the Great Artesian Basin it first appears in the Blythesdale Group with a vertical extension into the Tambo Formation (Albian).

Cyathidites asper (Bolkhovitina) comb. nov.

(Pl. I, fig. 10-16)

1953 *Stenozonotriletes asper* Bolkhovitina, p. 49; Pl. 7, fig. 2.
1959 *Lygodium asper* (Bolkhovitina) Bolkhovitina; Pl. 10, fig. 4.
1961 *Lygodium asper* (Bolkhovitina) Bolkhovitina (pars), p. 86-87; Pl. 27, fig. 2, 3; Pl. 34, fig. 2e, g (? fig. 2a-d); Pl. 41, fig. 4.
1962 *Concavisporites parkinii* Pocock, p. 46; Pl. 4, fig. 71.

DESCRIPTION: Microspores trilete, elliptical in polar outline; amb triangular with weakly concave sides and rounded angles. Laesurae straight, length ¾ or almost equal to spore radius; with weakly thickened margins and, in compressed specimens, flanked by 'lips' which are narrow (2-3 μ wide), equatorially tapering, oblique exposures of the exine. Exine 3·5-5 μ thick, one-layered, homogeneous in structure, and with an OL surface pattern.

DIMENSIONS: Equatorial diameter 60 (71) 86 μ; polar diameter (4 specimens) 34 (37) 42 μ.

REMARKS AND COMPARISONS: Specimens which are considered to be corroded representatives of *Cyathidites asper* (Bolkhovitina) show a granulate surface pattern (Pl. 1, fig. 14), and resemble *Callispora potoniei* Dev.

As noted previously, the species is distinct from *C. punctatus* in having a thicker exine and longer laesurae. *Lygodium subsimplex* Bolkhovitina and *L. japoniciforme* Ivanova show a smooth exine.

AFFINITY: Several Russian authors have noted that the species closely resembles the spores of *Lygodium japonicum* (Thbq.), *L. flexuosum* (L.), and *L. cubense* H.B.K. (see Bolkhovitina 1961, p. 79-81; Pl. 23, fig. 5a-c; Pl. 24, fig. 4).

DISTRIBUTION: Bolkhovitina (1961) records the species in Upper Jurassic-Turonian strata of U.S.S.R., but this stratigraphical range includes that of *C. punctatus*. Pocock (1962) subsequently recorded identical spores in Berriasian-Aptian strata of Canada. The species is widely distributed in SE. Australian Upper Mesozoic sediments (see Tables 3-9); in the Great Artesian Basin it first appears in the Blythesdale Group, and it ranges into the Winton Formation (? Cenomanian).

Cyathidites concavus (Bolkhovitina) comb. nov.

(Pl. I, fig. 17-19)

1953 *Stenozonotriletes concavus* Bolkhovitina, p. 46; Pl. 6, fig. 7.

DESCRIPTION: Microspores trilete; biconvex, the proximal surface strongly convex especially about the laesurae. Amb concavely triangular with convex, somewhat pointed, radial extremities. Laesurae straight, extending to amb. Exine 2·5-3·5 μ thick, smooth to faintly scabrate.

DIMENSIONS: Equatorial diameter 28 (43) 50 μ.

COMPARISON: The Australian spores are identical with *Cyathidites concavus* as defined by Bolkhovitina (1953, p. 46). They are distinct from *Concavisporites juriensis* Balme (1957, p. 20) in having a thicker exine, and in the constant absence of 'arcuate folds or thickenings' bordering the laesurae. The characteristically pointed radial extremities of the concavely triangular amb distinguishes *C. concavus* from other south-eastern Australian species of *Cyathidites*.

DISTRIBUTION: Described by Bolkhovitina (1953) from Aptian strata of the Moscow Basin, Russia, and reported herein from samples of the Blythesdale Group and Roma Formation (Aptian) in the Great Artesian Basin and from the lower intervals of bores in the Otway Basin (see Tables 3, 4, 6, 7).

Genus **Stereisporites** Pflug 1953

1937 *Sphagnumsporites Raatz* (nom. nud.), p. 9.
1953 *Stereisporites* Pflug in Thomson & Pflug, p. 53.
1953 *Sphagnites* Cookson, p. 463.
1956 *Sphagnumsporites* Raatz ex Potonié, p. 17.
1961 *Sphagnum* (Dill.) Ehrh.: Drozhastchich (pars) in Samoilovitch et al., p. 13.

TYPE SPECIES: *Stereisporites stereoides* (Potonié & Venitz) Pflug 1953.

REMARKS: As noted by Manum (1962, p. 26) *Stereisporites* Pflug (in Thomson and Pflug, March 1953) has priority over *Sphagnumsporites* Raatz ex Potonié; *Sphagnites* Cookson was instituted during October 1953 and is thus a later synonym of *Stereisporites*.

The holotype of the type species, *S. stereoides* (Potonié & Venitz), appears to have a uniformly thick exine (see Potonié and Venitz 1934; Pl. 1, fig. 4), but other illustrated specimens allocated to the species show weak exinal thickenings in the equatorial, radial regions (see Potonié and Venitz 1934; Pl. 1, fig. 5: Thomson and Pflug 1953, Pl. 1, fig. 64, 65, 73). Similar exinal thickenings are exhibited by the Australian representatives of *S. antiquasporites* (Wilson & Webster), and these spores should eventually be assigned to the Auriculati.

Stereisporites antiquasporites (Wilson & Webster) comb. nov.

(Pl. I, fig. 20, 21)

SELECTED SYNONYMY:

1946 *Sphagnum antiquasporites* Wilson & Webster, p. 273; Fig. 2.
1953 cf. *Sphagnites australis* (Cookson) f. *parva* Cookson, p. 469; Pl. 2, fig. 25, 26.
1956 *Sphagnumsporites antiquasporites* (Wilson & Webster) Potonié, p. 17.
1957 *Sphagnites australis* Cookson: Balme (pars), p. 15; Pl. 1, fig. 1, 2.
1962 *Sphagnumsporites antiquasporites* (Wilson & Webster) Pocock (pars), p. 32; Pl. 1, fig. 1-3.

DESCRIPTION: Microspores trilete, biconvex; amb subcircular to subtriangular with convex sides and broadly rounded angles. Laesurae straight, simple, length $\frac{1}{2}$-$\frac{3}{4}$ spore radius. Exine smooth, 1-2 μ thick; with slight thickenings in the radial regions at the equator and a low, distal polar thickening which is circular in outline and 6-8 μ in diameter.

DIMENSIONS: Equatorial diameter 20 (27) 36 μ.

REMARKS AND COMPARISON: Some variation in the length of the laesurae is shown by the spores here assigned to *Stereisporites antiquasporites* (Wilson & Webster). However, all have a smooth exine and a low, circular, distal polar thickening which is more clearly discernible in safranin-stained spores. A similar distal feature is seen in Cookson's form *Sphagnites australis* (Cookson) f. *crassa*, but this form is uniformly thickened at the equator and is referred subsequently to *Cingutriletes clavus* (Balme). The distal polar thickening distinguishes *S. antiquasporites* from several other species of the genus, including the type species, *S. stereoides* (Potonié & Venitz).

DISTRIBUTION: The species was found in most of the samples examined, including those of the Winton Formation (? Cenomanian) in the Great Artesian Basin (see Tables 3-9); it is particularly common in certain highly carbonaceous samples. In Western Australia the species is known from Jurassic and Lower Cretaceous deposits (Balme 1957), and similar forms have been recorded frequently from Mesozoic and Tertiary strata in other parts of the world.

Genus **Biretisporites** Delcourt & Sprumont emend. Delcourt, Dettmann, & Hughes 1963

SYNONYMY: See Delcourt, Dettmann, and Hughes 1963, p. 283.

TYPE SPECIES: *Biretisporites potoniaei* Delcourt & Sprumont 1955.

OTHER MESOZOIC SPECIES:

(1) *Biretisporites* (al. *Hymenophyllumsporites*) *deltoidus* (Rouse 1957, p. 363; Pl. 3, fig. 54-56) comb. nov. Occurrence: western Canada; Upper Cretaceous.
(2) *Biretisporites* (al. *Cingulatisporites*) *psilatus* (Groot & Penny 1960, p. 231; Pl. 2, fig. 21) comb. nov. Occurrence: eastern U.S.A.; Lower Cretaceous.
(3) *Biretisporites spectabilis* sp. nov.

Several Tertiary species assigned to *Leiotriletes* Naumova ex Potonié & Kremp by Krutzsch (1959, 1962) appear to be conformable with *Biretisporites* Delcourt & Sprumont.

REMARKS: Delcourt et al. (1963, p. 284) have shown that the type species is characterized by 'a smooth, uniformly thick exine and a trilete aperture enclosed with elevated lips'. Comparable features are exhibited by the other Mesozoic species here attributed to *Biretisporites*.

AFFINITY: Rouse (1957) suggests a relationship of his species, *B. deltoidus*, with *Hymenophyllum* L.

Biretisporites cf. **B. potoniaei** Delcourt & Sprumont 1955

(Pl. II, fig. 1, 2)

DESCRIPTION: Microspores trilete, biconvex; amb convexly subtriangular. Laesurae straight, approximating amb, and with narrow (1-1·5 μ wide), elevated (2-3 μ high) lips. Exine 1·5-2 μ thick, smooth.

DIMENSIONS: Equatorial diameter 34 (43) 56 μ.

REMARKS: The Australian specimens are similar to *Biretisporites potoniaei* Delcourt & Sprumont except that they have a thinner exine and are smaller in size.

DISTRIBUTION: The species is known from Wealden strata of Belgium and France (Delcourt and Sprumont 1955, 1959) and from Neocomian beds of Canada (Pocock 1962). The similar spores described above are widely dispersed in Upper Mesozoic deposits of SE. Australia (see Tables 3-8).

Biretisporites spectabilis sp. nov.

(Pl. II, fig. 3-8)

DIAGNOSIS: Microspores trilete, plano-convex, the distal surface strongly convex; amb triangular with rounded angles and straight to weakly concave or convex sides. Laesurae straight, extending to equator, and with conspicuous lips; lips, as shown in transverse sections, are narrow (2-3 μ wide), elevated (11-14 μ high), proximal extensions of the exine. Exine one-layered, 3·5-5 μ thick, homogeneous in structure, and with a faint LO surface pattern under oil immersion.

DIMENSIONS: Equatorial diameter 77 (104) 122 μ; polar diameter (9 specimens) 42 (65) 81 μ.

HOLOTYPE: Preparation D289/3 46·5 123·8 P21977; Pl. II, fig. 3, 4. Proximal aspect. Amb triangular, 111 μ in diameter. Laesurae 56 μ long. Exine 4·5 μ thick.

LOCUS TYPICUS: South Australia, Cootabarlow Bore No. 2 at 1,367-77 ft.

COMPARISON: The species is distinct from *Biretisporites deltoidus* (Rouse) in having a thicker exine and a larger size. *Leiotriletes selectiformis* Bolkhovitina has shorter laesurae, whilst *Biretisporites psilatus* (Groot & Penny) is considerably smaller.

DISTRIBUTION: Recovered from lower horizons only of the Upper Mesozoic successions in the Great Artesian and Otway Basins and in eastern Victoria (see Tables 3, 4, 6-8).

Genus **Dictyophyllidites** Couper emend.

1958 *Dictyophyllidites* Couper, p. 140.

EMENDED DIAGNOSIS: Microspores trilete; amb triangular. Exine smooth to faintly patterned; thickened about the laesurate margins. Laesurae enclosed within membraneous, elevated lips.

TYPE SPECIES: *Dictyophyllidites harrisii* Couper 1958. Occurrence: Britain; Jurassic.

OTHER SELECTED SPECIES:

(1) *Dictyophyllidites* (al. *Matonisporites*) *equiexinus* (Couper 1958, p. 140; Pl. 20, fig. 13, 14) comb. nov. Occurrence: Britain; Jurassic-Lower Cretaceous.
(2) *Dictyophyllidites* (al. *Matonia*) *pectinataeformis* (Bolkhovitina 1953, p. 56; Pl. 8, fig. 23) comb. nov.
(3) *Dictyophyllidites crenatus* sp. nov.

Many of the Tertiary species assigned by Krutzsch (1959, 1962) to his genera *Torioisporis, Toripunctisporis* and *Toripustulatisporites* appear to be comparable to *Dictyophyllidites* Couper.

REMARKS AND COMPARISON: *Dictyophyllidites* is emended herein to include both thin- and thick-walled, smooth to faintly patterned, trilete microspores having membraneous, elevated lips and thickened laesurate margins. The genus is thereby extended to incorporate the comparatively thick-exined, non-valvate spores of *Matonisporites* sensu Couper (1958).

Dictyophyllidites is distinct from *Biretisporites* Delcourt & Sprumont which does not have exinal thickenings about the laesurate margins; *Crassulina* Maljavikina ex Potonié lacks membraneous, elevated lips, and is considered by Potonié (1958) to be characterized by a loosely enveloped intexine (mesospore).

AFFINITY: Couper (1958) demonstrated that the type species is comparable to the spores of the Jurassic *Dictyophyllum rugosum* L. & H., and that *Dictyophyllidites equiexinus* (Couper) is similar to the Mesozoic matoniaceous species, *Phlebopteris angustiloba* (Presl.) and *Matonidium goepperti* (Ett.). The resemblance of *D. pectinataeformis* to the spores of the living *Matonia pectinata* R. Br. has been noted by Bolkhovitina (1953). Other associated microspores that conform with *Dictyophyllidites* include the spores described by Harris, T. M. (1961, p. 104; Fig. 34) from *Phlebopteris polypodioides* Brongn.

Dictyophyllidites pectinataeformis (Bolkhovitina) comb. nov.

(Pl. II, fig. 9-12)

1953 *Matonia pectinataeformis* Bolkhovitina, p. 56; Pl. 8, fig. 23.

DESCRIPTION: Microspores trilete; amb triangular with straight or concave sides and rounded angles. Laesurae straight, extending to amb; enclosed within membraneous lips (1-2 μ high) and bordered by convex, granulate exinal areas (5-6 μ

wide) which are thickened towards laesurate margins. Exine 3·5-5 μ thick; with perceptible sculptural elevations.

DIMENSIONS: Equatorial diameter (10 specimens) 53 (58) 64 μ.

COMPARISON: This distinctive species is readily distinguishable from other species of *Dictyophyllidites* in having a finely sculptured exine.

Bolkhovitina (1953) noted that the species resembles the spores of *Matonia pectinata* R. Br.; these modern spores are described by Couper (1958, p. 117; Pl. 20, fig. 11, 12).

DISTRIBUTION: The species was described from Cenomanian-Turonian strata of the southern Urals, Russia (Bolkhovitina 1953), and has been recovered from two samples of the Otway Basin (see Tables 5, 7).

Dictyophyllidites crenatus sp. nov.

(Pl. III, fig. 1-5)

DIAGNOSIS: Microspores trilete, biconvex; amb triangular with concave to straight sides and rounded angles. Laesurae sinuous, length at least ¾ spore radius; bordered by crenate, weakly thickened margins and enclosed within membraneous, elevated (2-3 μ high) lips. Exine smooth, 2·5-3·5 μ thick.

DIMENSIONS: Equatorial diameter 45 (55) 70 μ; polar diameter (6 specimens) 35 (38) 42 μ.

HOLOTYPE: Preparation D302/17 38·0 119·4 P21981; Pl. III, fig. 1, 2. Proximal aspect. Amb 49 μ in diameter, concavely triangular. Laesurae sinuous, 30 μ long, and with membraneous lips 3 μ high. Exine smooth, 3 μ thick but thicker about laesurae.

LOCUS TYPICUS: South Australia, Cootabarlow Bore No. 2 at 1,469-70 ft.

COMPARISON: *Dictyophyllidites crenatus* sp. nov. is distinct from *D. harrisii* Couper in having sinuous laesurae and a thicker exine. It resembles *D. equiexinus* (Couper) which, however, has a convexly triangular amb. *Trilites sinuatus* Couper shows a greater development of thickening about the laesurate margins. The illustrated specimen assigned to *Sporites adriennis* Potonié cf. *mesozoicus* Thiergart (1949, p. 11; Pl. 2, fig. 3) and that of *Concavisporites antweilerensis* Pflug (in Thomson and Pflug 1953, p. 50; Pl. 1, fig. 43) resemble *D. crenatus* but apparently lack elevated laesurate lips.

As discussed subsequently probable corroded representatives of *D. crenatus* conform with *Foveotriletes parviretus* (Balme).

DISTRIBUTION: A widely distributed species in the Upper Mesozoic of SE. Australia (see Tables 3-9). It is more common in samples examined from E. Victoria and from the lower horizons of the Otway and Great Artesian Basins.

Infraturma APICULATI Bennie & Kidston emend. Potonié 1956

The azonate, acavate, trilete spores of this infraturma are sculptured with elevations including granula, verrucae, spinae, bacula, capilli, etc. The sculptural elevations usually are discrete and their bases are less than twice as long as wide. As in Laevigati Bennie & Kidston the laesurae may be simple or lipped; thus, the apiculate spores of Pyrobolotriletes, Capulitriletes, Lagenotriletes, and Barbates conform with the Infraturma Apiculati Bennie & Kidston.

Genus **Leptolepidites** Couper 1953

TYPE SPECIES: *Leptolepidites verrucatus* Couper 1953.

REMARKS: Trilete, verrucate microspores which are almost certainly identical to the type species of *Leptolepidites* Couper have been recovered in the present investigation. Contrary to the generic diagnosis, these spores are smooth proximally.

The genus appears to be similar to *Rubinella* Maljavikina ex Potonié, but the detailed morphology of the latter genus has not been illustrated precisely.

Leptolepidites verrucatus Couper 1953

(Pl. III, fig. 6-9)

DESCRIPTION: Microspores trilete, biconvex; amb sub-triangular with straight to convex sides. Laesurae indistinct, simple, straight, extending to equator. Exine thin; smooth proximally, verrucate both equatorially and distally. Large, closely-spaced verrucae, hemispherical to subhemispherical, 3-5 μ high, and 4-7 μ in basal diameter.

DIMENSIONS: Equatorial diameter (including sculpture) 28 (36) 45 μ.

COMPARISON: The SE. Australian specimens appear to be identical to those described from New Zealand by Couper (1953, p. 28; Pl. 2, fig. 14, 15), and they are devoid of proximal sculpture. *Leptolepidites verrucatus* Couper may be similar to *Rubinella bacciformis* Maljavikina, the illustration of which, however, depicts smaller and more crowded verrucae. *Leptolepia fossilis* Chlonova is distinct in having shorter laesurae and smaller verrucae.

Couper (1953) compared the species with the spores of *Leptolepia novae-zealandiae* (Col.), but, according to Erdtman (1957, p. 70; Fig. 131), these living spores show verrucae only on the perine. Potonié (1956, p. 27) suggests comparison with the specimen figured by Knox (1938, Fig. 77) of *Alsophila chimborazensis* Hk. (not *A. cooperi* F. Muell. which has spinose sculpture). Some of the spores which Knox (1950) included in her *Selaginella vaginata* group are not unlike the fossil species.

DISTRIBUTION: The species was described from probable Upper Jurassic of New Zealand (Couper 1953). Doubtful representatives of the species have subsequently been recorded by de Jersey (1959) from the Lower Jurassic Walloon Coal Measures of Queensland, and by Lantz (1958b) from the Corallian and Purbeckian of England. The species occurs in the majority of the samples examined in the present study (see Tables 3-9). Additional E. Australian occurrences, including an Upper Cretaceous one, are given by Cookson and Dettmann (1958b, 1959a) and Dettmann (1959).

Leptolepidites major Couper 1958

(Pl. III, fig. 10-12)

1958 *Leptolepidites major* Couper, p. 141; Pl. 21, fig. 7, 8.
1961 *Selaginella orbiculata* Krasnova in Samoilovitch et al. p. 23; Pl. 3, fig. 3-5 (? fig. 6).

DESCRIPTION: Microspores trilete, biconvex; amb circular to subcircular. Laesurae indistinct, straight, length ¾ spore radius. Exine verrucate, about 3 μ thick (inclusive of sculpture). Verrucae rather variable in size, dome-shaped, and with circular to irregular bases. Distal verrucae closely-spaced, 1-3 μ high, and 3-8 μ in basal diameter; proximal verrucae lower and usually linearly arranged along laesurate margins.

Dimensions: Equatorial diameter (inclusive of sculpture) 36 (44) 50 μ.

Comparison: The specimen figured by Rouse (1957; Pl. 3, fig. 78) shows a striking resemblance to the species, but apparently differs in having 'more reticulate than setaceous sculpture'. *Leptolepidites major* Couper is distinct from *L. verrucatus* Couper which is smaller and which has a sub-triangular amb; *Selaginella granata* Bolkhovitina which has smaller and more uniform verrucae; and *Gemmatriletes morulus* Pierce which has gemmate sculpture. Furthermore, in its smaller size and smaller verrucae *L. major* is distinct from *Lygodium corrugatus* Bolkhovitina and *Hymenozonotriletes speciosus* Baldakyte-Vienozinskiene.

Krasnova (in Samoilovitch et al. 1961, p. 23) compares the species with spores of *Selaginella repanda* (Desv.) (see also Knox 1950, p. 269; Pl. 4, fig. 143).

Distribution: The species has been reported from Middle Jurassic of Britain (Couper 1958) and Valanginian-?Cenomanian of W. Siberia (Samoilovitch et al. 1961). The similar specimen figured by Rouse (1957) is from the Upper Cretaceous of Canada. *L. major* shows wide distribution, both laterally and vertically, in the Upper Mesozoic of SE. Australia (see Tables 4-8).

Genus **Concavissimisporites** Delcourt & Sprumont emend. Delcourt, Dettmann, & Hughes 1963

Synonymy: See Delcourt, Dettmann, and Hughes 1963, p. 284.

Type Species: *Concavissimisporites verrucosus* Delcourt & Sprumont 1955.

Remarks: After a reappraisal of the type species and following Potonié's (1956) informal proposal, Delcourt et al. (1963) emended the genus to incorporate trilete, azonate microspores characterized by a concavely triangular amb and verrucate sculpture. Details of the verrucae preserved in the type and other species, *Concavissimisporites verrucosus* Delcourt & Sprumont, *C. crassatus* (Delcourt & Sprumont), and *C. penolaensis* sp. nov., are shown in Fig. 4a-c (see also Delcourt et al. 1963; Pl. 42, fig. 6, 7, 10, 11). Unfortunately the sculptural features have not been clearly detailed and depicted for many of the species which appear to be conformable with the genus. Such species have been widely recognized in Upper Mesozoic sediments from many parts of the world, and many of those described from the U.S.S.R. have been assigned to the modern genus *Lygodium* Swartz (see Kara-Murza 1954, Maljavikina 1958, Bolkhovitina 1961, Samoilovitch et al. 1961, Verbitskaya 1962).

Comparison: *Concavissimisporites* Delcourt & Sprumont is distinct from *Trilobosporites* Pant ex Potonié which has a differentially thickened exine and/or larger sculptural elements about the radial regions at the equator. *Converrucosisporites* Potonié & Kremp shows similar sculptural features, but it includes spores in which the amb has 'weakly concave or also slightly to strongly convex sides' (Bhardwaj 1957b, p. 115). *Leptolepidites* Couper, *Rubinella* Maljavikina ex Potonié, and *Verrucosisporites* Ibrahim show a convexly triangular amb; and *Trilites* Erdtman ex Couper possesses a differentially thickened exine (see discussion herein of *Trilites*).

Affinity: Microspores morphologically comparable to *Concavissimisporites* have been described in various living species of *Cyathea* Smith, *Dicksonia* L'Herit, and *Lygodium* Swartz (see Harris, W. F. 1955, Erdtman 1957, Couper 1958, Bolkhovitina 1961).

Concavissimisporites penolaensis sp. nov.

(Pl. III, fig. 13-16; Fig. 4c)

DIAGNOSIS: Microspores trilete; amb triangular with rounded angles and straight or weakly concave sides. Laesurae straight, length ¾ spore radius. Exine 3-4 μ thick, verrucate; verrucae 1-1·5 μ high and with polygonal or occasionally circular bases 2-4 μ in diameter. Verrucae usually more crowded on distal surface and linearly arranged about laesurate margins.

DIMENSIONS: (20 specimens) Equatorial diameter 52 (64) 81 μ.

HOLOTYPE: Preparation D295/1 54·9 108·9 P21968; Pl. III, fig. 13-15. Proximal aspect. Amb triangular, 76 μ in diameter (maximum radial length 46 μ). Laesurae 37 μ long. Exine 3·5 μ thick; with low, polygonal-based verrucae which are more closely spaced distally.

LOCUS TYPICUS: South Australia, Penola Bore No. 1 at 1,610-20 ft.

COMPARISON: The species may be conspecific with *Lygodium inundatum* Kara-Murza, the illustration (see Bolkhovitina 1961; Pl. 30, fig. 3) of which, however, does not precisely depict the laesurate and sculptural features. The holotype of *Concavissimisporites minor* (Pocock) is insufficiently well preserved for detailed comparison with *C. penolaensis* sp. nov. A direct comparison of *C. penolaensis* with the type specimens of *C. crassatus* (Delcourt & Sprumont) and *Concavisporites variverrucatus* Couper reveals that the Australian species is distinct in having a more coarsely sculptured exine, shorter laesurae, and less broadly rounded amb-angles. Further, *Concavissimisporites penolaensis* is distinct from *C. baculatus* Lantz and Kara-Murza's species, *Lygodium gibberulum* and *L. valanjinensis*, in having low, polygonal-based verrucae. *L. cretaceum* Chlonova has rugulate sculpture and shorter laesurae, whilst *L. triangulatum* Ivanova possesses a differentially thickened exine.

The species differs only in sculpture from the Australian representatives of *Cyathidites asper* (Bolkhovitina). Spores comparable to both species have been described in *Lygodium flexuosum* (L.) (see Bolkhovitina 1961; Pl. 23, fig. 5a-c), and this may suggest that the fossil species originated in closely related plants.

DISTRIBUTION: The species was recovered from only a few samples taken from the Otway Basin (see Tables 5, 7). The similar form, *Lygodium inundatum*, has been reported from Valanginian-Lower Aptian strata of Siberia (Bolkhovitina 1961).

Genus **Osmundacidites** Couper 1953

1953 *Osmundacidites* Couper, p. 20.
1959 *Baculatisporites* Thomson & Pflug: Krutzsch (pars), p. 138.
1960 *Conosmundacidites* Klaus, p. 127.
1961 *Osmunda* L.: Klimko (pars) in Samoilovitch et al., p. 112.

TYPE SPECIES: *Osmundacidites wellmanii* Couper 1953.

DISCUSSION: *Osmundacidites* Couper, *Baculatisporites* Thomson & Pflug, and *Rugulatisporites* Thomson & Pflug are similar in shape, but are distinguishable on their sculptural features. *Osmundacidites* possesses a predominantly granulate exine and is distinct from *Baculatisporites* which has baculate sculpture (cf. Krutzsch 1959) and *Rugulatisporites* which is characterized by a rugulate exine.

Conosmundacidites Klaus is almost certainly synonymous with *Osmundacidites*; the thickened lips seen in *C. othmari* Klaus comprise coalescent granules which are linearly arranged along the laesurate margins. A similar feature is exhibited by *O. wellmanii* Couper (1960; Pl. 1, fig. 1).

AFFINITY: Couper (1953, 1958, 1960) compared the type species with spores of several fossil representatives of the Osmundaceae (*Osmundopsis plectrophora* Harris, *Todites hartzi* Harris, and *T. undans* (Brongn.)). Comparable spores are known also in the fossil *Osmundopsis sturi* (Raciborski) (see Harris, T. M. 1961, p. 99, Fig. 32) and in the living *Osmunda japonicum* Thunberg and *O. claytonia* L. (see Nakamura and Shibasaki 1959).

Osmundacidites wellmanii Couper 1953

(Pl. III, fig. 19-21; Fig. 4g, h)

1953 *Osmundacidites wellmanii* Couper, p. 20; Pl. 1, fig. 5.
1959 *Baculatisporites wellmanii* (Couper) Krutzsch, p. 142.
1962 *Osmundacidites wellmanii* Couper: Pocock (pars), p. 35; Pl. 1, fig. 15.

DESCRIPTION: Microspores spherical, but often distorted and with arcuate folds; amb circular in undistorted specimens. Exine thin (0·5-1·5 μ thick), granulate; grana with irregular, sometimes confluent bases. Laesurae straight, length greater than ¾ spore radius, and with granulate margins.

DIMENSIONS: Equatorial diameter 36 (51) 67 μ.

REMARKS AND COMPARISON: *Osmundacidites wellmanii*, as defined by Couper (1953, 1958), is a broad type, and the Australian spores described above show

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FIG. 4—Drawings from photographs; all magnifications × *c*. 850. (a) *Concavissimisporites verrucosus* Delcourt & Sprumont. Holotype; optical section and surface view of exine in equatorial, radial region (see also Delcourt et al. 1963; Pl. 42, fig. 6, 7); (b) *Concavissimisporites crassatus* (Delcourt & Sprumont). Holotype; optical section and surface view of exine in equatorial, radial region (see also Delcourt et al. 1963; Pl. 42, fig. 10, 11); (c) *Concavissimisporites penolaensis* sp. nov.; optical section and surface view of exine in equatorial, radial region (see also Pl. III, fig. 16) Robe Bore No. 1 at 1,400 ft, ICC60/4 40·7 119·0 (P21988); (d) *Pilosisporites notensis* Cookson & Dettmann; exine in section (see Pl. IV, fig. 5; Robe Bore No. 1 at 3,860 ft, D226/S70a/3 54·6 126·9 P21996) and surface view (Robe Bore at 3,860 ft, D226/11 40·7 117·3 P22583); (e) *Pilosisporites grandis* sp. nov.; optical section and surface view of exine in equatorial, radial region (see also Pl. V, fig. 3); Cootabarlow Bore No. 2 at 770-880 ft, D325/3 37·3 117·1 (P22000); (f) *Pilosisporites parvispinosus* sp. nov. Holotype; optical section and surface view of exine in equatorial, radial region (see also Pl. IV, fig. 6, 7); Comaum Bore No. 2 at 708 ft, D248/1 26·9 116·3 (P21997); (g) *Osmundacidites wellmanii* Couper; optical section and surface view of specimen having a thick exine and large, coalescent granules (see also Pl. III, fig. 19); Koppcramanna Bore at 2,970 ft, D241/3 44·4 122·3 (P21990); (h) *Osmundacidites wellmanii* Couper; optical section and surface view of specimen having a thin exine and small granules; Cootabarlow Bore No. 2 at 1,391-92 ft, D288/1 23·2 116·2 (P22144); (k) *Baculatisporites comaumensis* (Cookson); optical section and surface view of equatorial exine (see also Pl. III, fig. 22, 23); Barongarook Creek, sample P22585, D203/1 43·5 109·9 (P21992); (l) *Lycopodiacidites asperatus* sp. nov.; optical section and surface view of equatorial exine; Cootabarlow Bore No. 2 at 1,340 ft, D290/1 52·1 110·6 (P21991); (m) *Neoraistrickia truncatus* (Cookson); optical section of equatorial exine; Cape Paterson, sample P22601, D162/1 45·8 125·5 (P22019); (n) *Ceratosporites equalis* Cookson & Dettmann; optical section of equatorial exine (see also Pl. V, fig. 6); Cootabarlow Bore No. 2 at 1,469-70 ft, D302/1 32·1 126·9 (P22002); (o) *Foraminisporis wonthaggiensis* (Cookson & Dettmann) optical section of distal exine (see also Pl. XIV, fig. 19-21); Cootabarlow Bore No. 2 at 1,376-77 ft, D289/1 20·2 122·3 (P22038); (p) *Cicatricosisporites australiensis* (Cookson) surface view of equatorial, radial exine showing proximo-equatorial muri (see also Pl. IX, fig. 12, 13, 15); Robe Bore No. 1 at 2,630 ft, D259/4 38·7 120·1 (P22034); (r) *Cicatricosisporites hughesi* sp. nov.; surface view of equatorial, radial exine showing proximo-equatorial muri, Penola Bore No. 1 at 1,805-15 ft, D294/1 49·6 128·7 (P21965).


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considerable variation in the thickness and sculpture of the exine. Specimens (Pl. III, fig. 20, 21) which have a thin (less than 1 μ thick) exine show small, widely-spaced granules, and those (Pl. III, fig. 19) in which the exine is thicker (1-1·5 μ) possess larger, usually coalescent granules. However, subdivision of the species into more restricted units has not been attempted owing to the occurrence of 'intermediate' forms.

An even broader definition of the species is given by Pocock (1962) who attributes to it both *Baculatisporites comaumensis* (Cookson) and *'Osmundasporites' elongatus* Rouse. *Osmundacidites wellmanii* is distinct from these species, however, in having granulate sculpture.

The species is similar to *Lophotriletes bjutainensis* Bolkhovitina, but differs in its smaller size and longer laesurae. *Osmunda tuberculata* Klimko has shorter laesurae, *Osmundacidites alpinus* Klaus is considerably smaller, and both *O. senectus* Balme and *Osmunda elongatus* Klimko have more conical sculptural elements.

DISTRIBUTION: The species is common throughout the Upper Mesozoic of SE. Australia (see Tables 3-9), and is known from Lower Jurassic strata of Queensland (de Jersey 1959). Its known geological range is Liassic to Middle Senonian (Couper 1960).

Osmundacidites mollis (Cookson & Dettmann) comb. nov.

(Pl. III, fig. 17, 18)

1958 *Lycospora mollis* Cookson & Dettmann, p. 111; Pl. 17, fig. 14-17.

DESCRIPTION: Microspores trilete, spheroidal. Laesurae straight, extending almost to amb, and with weakly thickened margins. Exine 1-1·5 μ thick, finely granulate. The 'subequatorial ridge' of Cookson and Dettmann (1958b, p. 111) constitutes a narrow, unthickened bulge in the equatorial exine.

DIMENSIONS: Equatorial diameter 28 (39) 48 μ; polar diameter 28 (31) 36 μ.

REMARKS AND COMPARISON: The unthickened nature of the equatorial exine is clearly seen in optical sections of spores situated in equatorial aspect (see Cookson and Dettmann 1958b; Pl. 17, fig. 16: present study; Pl. III, fig. 18). The species is distinct from *Osmundacidites wellmanii* Couper which has coarser and more closely spaced granules, and *Todisporites minor* Couper which possesses a smooth exine.

DISTRIBUTION: The species is of infrequent occurrence, and shows wide distribution in the Upper Mesozoic of SE. Australia (Cookson and Dettmann 1958b; Dettmann 1959; present study, Tables 4, 6-9).

Genus **Baculatisporites** Thomson & Pflug 1953

1953 *Baculatisporites* Thomson & Pflug, p. 56.
1959 *Baculatisporites* Thomson & Pflug: Krutzsch (pars), p. 138.

TYPE SPECIES: *Baculatisporites primarius* (Wolff) Thomson & Pflug 1953.

REMARKS: As noted previously, this genus is distinct from *Osmundacidites* Couper in having baculate, and not granulate, sculpture (cf. Krutzsch 1959). *Conbaculatisporites* Klaus shows similar baculate sculpture but differs in having a triangular amb.

AFFINITY: Morphologically comparable spores occur in the Osmundaceae e.g. in *Osmunda cinnamomea* L. and *O. bromerifolia* Copeland (see Nakamura and Shibasaki 1959).

Baculatisporites comaumensis (Cookson) Potonié 1956

(Pl. III, fig. 22, 23; Fig. 4k)

1953 *Trilites comaumensis* Cookson, p. 470; Pl. 2, fig. 27, 28.
1956 *Baculatisporites comaumensis* (Cookson) Potonié, p. 23.
1957 *Osmundacidites comaumensis* (Cookson) Balme, p. 25; Pl. 4, fig. 54-56.
1962 non *Osmundacidites wellmanii* Couper: Pocock, p. 35; Pl. 1, fig. 15.

DESCRIPTION: Microspores biconvex in undistorted specimens; amb circular. Exine *c.* 1 μ thick; sculptured with short, equidimensional bacula together with a few setulae and clavae. Sculptural elements 1-1·5 μ long and 1-1·5 μ in diameter; randomly disposed 1-3 μ apart, except along laesurate margins where they are linearly and more closely arranged. Laesurae straight, length ¾ spore radius.

DIMENSIONS: Equatorial diameter 27 (45) 62 μ.

COMPARISON: The species is similar to *Osmunda crassirimosa* Klimko and *Baculatisporites primarius* (Wolff), both of which, however, have smaller bacula. *B. comaumensis* (Cookson) is distinct from Krutzsch's (1959) Tertiary species on the form and size of its bacula.

Cookson (1953) compared the species with the spores of *Todea* Willd. and *Leptopteris* Presl.; it resembles also the spores of certain species of *Osmunda* L. e.g., *O. cinnamomea* L.

DISTRIBUTION: Balme (1957) recorded the species in Jurassic-Lower Cretaceous strata of Western Australia, and Klaus (1960) reports it from the Upper Triassic of Europe. It is of common occurrence throughout the Upper Mesozoic of SE. Australia (Cookson and Dettmann 1958b, 1959a; Dettmann 1959; present study, Tables 3-9), and similar spores are known from Quaternary strata of Victoria (Duigan and Cookson 1956).

Genus **Neoraistrickia** Potonié 1956

1949 *Cepulina* Maljavikina (pars), p. 73.
1956 *Neoraistrickia* Potonié, p. 34.
1959 *Reticulatisporites*? Ibrahim: Krutzsch, p. 162.

TYPE SPECIES: *Neoraistrickia truncatus* (Cookson) Potonié 1956.

DISCUSSION: Potonié (1956) instituted the genus to incorporate trilete, azonate, Mesozoic microspores which show a sculpture pattern composed solely of bacula. Comparable morphology is found in the more widely circumscribed genus *Cepulina* Maljavikina which is a partial synonym of *Neoraistrickia* Potonié (see Potonié 1960, p. 44). The type of *Anemiidites* Ross, as it is depicted in the original illustrations (Ross 1949; Pl. 1, fig. 17, 18), shows baculate sculptural elements, but these elements are described as 'spines about 2 μ long' (Ross 1949, p. 32).

The sculpture of *Neoraistrickia* is similar to that of the Palaeozoic genus *Raistrickia* Schopf, Wilson, & Bentall which, however, also includes forms with additional spinulae and/or coni (see Potonié 1956, p. 73; Bhardwaj 1957a, Fig. 4). Baculate sculpture is diagnosed for *Baculatisporites* Thomson & Pflug, but *Neoraistrickia* differs in its subtriangular amb and in having larger and more widely distributed bacula. The genus is distinct also from *Ceratosporites* Cookson & Dettmann which has a smooth proximal exine and narrow-based clavae, setulae, and capillae distally.

AFFINITY: Spores attributable to *Neoraistrickia* are similar to those found in modern *Selaginella* Spring e.g., in the *S. stolonifera* and *S. biformis* groups of Knox (1950), and in *Lycopodium densum* La Billard (see Couper 1958, Samoilovitch et al. 1961).

Neoraistrickia truncatus (Cookson) Potonié 1956

(Pl. V, fig. 4, 5; Fig. 4m)

1953 *Trilites truncatus* Cookson, p. 471; Pl. 2, fig. 36.
1956 *Neoraistrickia truncatus* (Cookson) Potonié, p. 34.
1957 *Baculatisporites truncatus* (Cookson) Balme, p. 18; Pl. 1, fig. 21, 22 (? fig. 20).
1958 *Lycopodiumsporites gristhorpensis* Couper, p. 135; Pl. 15, fig. 14, 15 (? fig. 16).
1959 *Reticulatisporites? truncatus* (Cookson) Krutzsch, p. 162.
1962 non *Lycopodiumsporites gristhorpensis* Couper: Pocock, p. 33; Pl. 1, fig. 9.

DESCRIPTION: Microspores trilete; amb roundly triangular. Laesurae straight, extending to amb, and with membraneous, elevated (1-2 μ high) lips. Exine 1·5-2 μ thick, baculate. Distal bacula spaced 4-7 μ apart; with circular bases 2-3 μ in diameter, constricted columns 2·5-4·5 μ high, and truncated distal extremities 1-2 μ in diameter. Proximal bacula inconspicuous and sparsely distributed.

DIMENSIONS: Equatorial diameter (including sculpture) 28 (34) 40 μ.

COMPARISON: The species is similar to *Neoraistrickia neozealandica* (Couper), *Selaginella rotundiformis* Kara-Murza, and *Raistrickia obtusispinosa* Rouse, but differs in showing smaller and more sparsely disposed bacula. *Lophotriletes testatus* Bolkhovitina and Rogalska's specimen (1956; Pl. 29, fig. 3) of *Spinosisporites minimus* Jachowicz are distinct in having shorter laesurae; *Selaginella rareverrucosa* Chlonova shows verrucate sculpture; and *Anemiidites echinatus* Ross has a concavely triangular amb.

Couper (1958, p. 133) states that the 'nearest living counterpart' of the British specimens are to be found in *Lycopodium densum* La Billard. Other spores which are similar to *Neoraistrickia truncatus* include those of Knox's (1950) *Selaginella biformis* group.

DISTRIBUTION: The species is widely distributed in the Upper Mesozoic of SE. Australia (Cookson 1953; Cookson and Dettmann 1958b, 1959a; Dettmann 1959; present study, Tables 3-9). Other documented occurrences include Upper Jurassic-Lower Cretaceous of Western Australia (Balme 1957) and Middle Jurassic of Britain (Couper 1958).

Genus **Ceratosporites** Cookson & Dettmann 1958

TYPE SPECIES: *Ceratosporites equalis* Cookson & Dettmann 1958.

COMPARISON: The genus is distinct from *Neoraistrickia* Potonié in having a smooth proximal exine together with clavae, setulae, and capillae distally.

AFFINITY: Cookson and Dettmann (1958b) compared the type species with the spores of the *Selaginella latifrons* group of Knox (1950).

Ceratosporites equalis Cookson & Dettmann 1958

(Pl. V, fig. 6-8; Fig. 4n)

DESCRIPTION: Microspores trilete, tetrahedral; distal surface convex, proximal surface pyramidal. Amb convexly subtriangular. Laesurae straight, extending almost to amb, and with membraneous, elevated (2-4 μ high) lips. Exine 1-1·5 μ thick, smooth to faintly scabrate proximally. Distal surface sculptured with slender clavate to capillate, and occasionally spinulate to setulate, elements. Elements spaced 3-4 μ apart; with narrow (1-2 μ wide) bases and slightly constricted columns (3-7 μ high) which broaden and sometimes bifurcate towards their distal extremities.

DIMENSIONS: Equatorial diameter (including sculpture) 34 (44) 56 μ; polar diameter (5 specimens) 34 (40) 45 μ.

COMPARISON: The species shows a striking resemblance to *Selaginella tenuispinulosa* Krasnova, which, however, includes spores with comprehensive spinose sculpture. *Ceratosporites equalis* Cookson & Dettmann is similar to Bolkhovitina's (1956) species, *Alsophila parvispinosa*, and to the spores which she previously (1953) assigned to *Acanthotriletes typicus* Naumova, but the Australian species is distinct in having longer sculptural elements. *C. equalis* is distinct also from *Acanthotriletes levidensis* Balme and *Selaginella diuturna* Bolkhovitina, both of which possess tapering spinae. *Pteris paleouncinnata* Bolkhovitina has shorter laesurae and more widely spaced sculptural elements, and *Lycopodiacidites baculatus* Pocock is larger and has reticulate sculpture.

DISTRIBUTION: A widely distributed species in SE. Australian Upper Mesozoic sediments (Cookson and Dettmann 1958b, 1959a; Dettmann 1959; present study, Tables 3-9).

Genus **Pilosisporites** Delcourt & Sprumont 1955

1955 *Pilosisporites* Delcourt & Sprumont, p. 34.
1961 *Lygodium* Swartz: Bolkhovitina (pars), p. 102.
1961 *Lygodium* Swartz: Ivanova (pars) in Samoilovitch et al., p. 90.

TYPE SPECIES: *Pilosisporites trichopapillosus* (Thiergart) Delcourt & Sprumont 1955.

AFFINITY: Definite evidence of the botanical affinity of this distinctive group of spores appears to be lacking; certainly there is no evidence for a schizaeaceous relationship (cf. Bolkhovitina 1961, Samoilovitch et al. 1961).

Pilosisporites notensis Cookson & Dettmann 1958

(Pl. IV, fig. 1-5; Fig. 4d)

1958 *Pilosisporites notensis* Cookson & Dettmann (pars), p. 102; Pl. 15, fig. 1, 3.
1961 *Lygodium notensis* (Cookson & Dettmann) Bolkhovitina, p. 103; Pl. 38, fig. 7.

DESCRIPTION: Microspores trilete, biconvex; amb triangular with concave to almost straight sides and broadly rounded angles. Laesurae straight, length about ⅔ spore radius; enclosed within membraneous, elevated (2-3 μ high) lips which have serrated crests. Exine one-layered, 2-3·5 μ thick, and sculptured with conical elements which are 1-2 μ in basal diameter and 2-4 μ high. Sculptural elements densely disposed about equatorial, radial regions and sparsely distributed over polar regions; closely-spaced and linearly arranged at laesurate margins.

DIMENSIONS: Equatorial diameter 76 (95) 111 μ; polar diameter (2 specimens) 76, 80 μ.

COMPARISON: One of the illustrated spores which Cookson and Dettmann (1958b; Pl. 15, fig. 2) included within their *Pilosisporites notensis* is now considered to represent a distinct species, and is subsequently allocated to *P. parvispinosus* sp. nov. *P. notensis* resembles one of the illustrated specimens of *Lygodium setiferum* Verbitskaya (1962; Pl. 11, fig. 53b), but the holotype (loc. cit.; Pl. 11, fig. 53c) of the Russian species is distinct from *P. notensis* in having longer and more crowded elements which are straight sided. *P. notensis* is distinct from *P. verus* Delcourt & Sprumont in having shorter and more evenly distributed conical elements and from *Lygodium calvum* Ivanova which has a thinner exine and smaller and more sparsely disposed elements about the laesurae.

Distribution: The species shows wide lateral distribution in the Upper Mesozoic of SE. Australia (see Tables 4-9); in the Great Artesian Basin it was found only in samples of the Blythesdale Group and Roma Formation (Aptian). Previous records (Cookson and Dettmann 1958b, 1959a; Dettmann 1959) include occurrences of *P. notensis, P. parvispinosus,* and *P. grandis* sp. nov.

Pilosisporites parvispinosus sp. nov.

(Pl. IV, fig. 6-8; Fig. 4f)

1958 *Pilosisporites notensis* Cookson & Dettman (pars), p. 102; Pl. 15, fig. 1.

Diagnosis: Microspores trilete, biconvex; amb concavely triangular. Laesurae straight, length ⅔ spore radius, and with membraneous, elevated (2-5 μ high) lips. Exine 2-3 μ thick, spinulate; small blunt to pointed spinules (1-2 μ high, 1 μ in basal diameter) more closely spaced in equatorial, radial regions and linearly arranged about laesurae.

Dimensions: Equatorial diameter (19 specimens) 78 (98) 117 μ.

Holotype: Preparation D248/1 26·9 116·3 P21997; Pl. IV, fig. 6, 7; Fig. 4f. Proximal aspect. Amb concavely triangular, 111 μ in diameter (62 μ in maximum radial length). Laesurae 39 μ long. Exine 2 μ thick; spinules more crowded in equatorial, radial regions and linearly arranged about, and 5 μ from, laesurate margins.

Locus Typicus: South Australia, Comaum Bore No. 2 at 708 ft.

Comparison: The species may be comparable to the specimen depicted by Verbitskaya (1962; Pl. 11, fig. 53a) of her species *Lygodium setiferum. Pilosisporites parvispinosus* sp. nov. is distinct from *P. notensis* Cookson & Dettmann in having shorter and more widely spaced spinules.

Distribution: The species is widely dispersed in SE. Australia (see Tables 4-9); it appears to be restricted to the Roma (Aptian) and Tambo (Albian) Formations in the Great Artesian Basin.

Pilosisporites grandis sp. nov.

(Pl. V, fig. 1-3; Fig. 4e)

Diagnosis: Microspores trilete; amb concavely triangular. Laesurae straight, length ⅔ spore radius, and with membraneous, elevated lips 2-3 μ high. Exine 4·5-5·5 μ thick; with closely-packed, sometimes coalescent, tapering spines which are 3-5 μ high and which have circular to irregular bases 1-3 μ in diameter. Spines more crowded on distal surface.

Dimensions: Equatorial diameter (19 specimens) 100 (117) 142 μ; polar diameter (1 specimen) 88 μ.

Holotype: Preparation 1CC/1 41·3 111·8 P22098; Pl. V, fig. 1, 2. Distal aspect. Amb concavely triangular, 136 μ in diameter (maximum radial length 78 μ). Laesurae 50 μ long. Exine 5·5 μ thick; spines 3-5 μ high; 1-3 μ in basal diameter.

Locus Typicus: Victoria, Pretty Hill Bore No. 1 at 2,928-80 ft.

Comparison: *Lygodium echinaceum* Verbitskaya and the figured specimens attributed to *Lygodium* sp. by Zauer and Mtchedlishvili (1954; Pl. 11, fig. 18, 19) resemble *Pilosisporites grandis* sp. nov. which is distinct, however, in having a larger size, thicker exine, and irregularly based spines.

Distribution: The species has been recovered from the uppermost horizons examined of the Upper Mesozoic sequences in the Great Artesian and Otway Basins (see Tables 5-7, 9).

Genus **Kuylisporites** Potonié 1956

TYPE SPECIES: *Kuylisporites waterbolki* Potonié 1956. Occurrence: Trinidad; Lower Tertiary: Holland; Senonian (after Krutzsch 1959).

OTHER SPECIES:

(1) *Kuylisporites mirabilis* (Bolkhovitina) Potonié 1958. Occurrence: U.S.S.R.; Cenomanian.
(2) *Kuylisporites* (al. *Hemitelia*) *separatus* (Chlonova 1960, p. 11; Pl. 1, fig. 6, 7) comb. nov. Occurrence: U.S.S.R.; Maastrichtian-Palaeocene (after Chlonova 1960, 1961).
(3) *Kuylisporites* (al. *Hemitelia*) sp. Samoilovitch et al. 1961; Pl. 79, fig. 4. Occurrence: U.S.S.R.; Maastrichtian.

The following species are not entirely conformable with *Kuylisporites*:

(1) *Kuylisporites lunaris* Cookson & Dettman 1958.
(2) *Brochotriletes degradatus* Verbitskaya 1958; Pl. 4, fig. 67; 1962, p. 118; Pl. 16, fig. 87a, b. Occurrence: U.S.S.R.; Aptian.

DISCUSSION: Krutzsch (1959, p. 190) claims that the genus is typified by *Kuylisporites mirabilis* (Bolkhovitina) because he considers that this species is homotaxial with *K. waterbolki* Potonié. It seems evident from the illustrations and description, however, that *K. waterbolki* is distinct from *K. mirabilis* in showing distal as well as equatorial scutula.

Dulhuntyispora Potonié has equatorial scutula, but *Kuylisporites* Potonié is distinguishable in the form of its lumina and in having lenticulate scutula. *Kuylisporites* is distinct also from *Camursporis* Chlonova in which the equatorial structures appear to be comparable to the 'colpoid' areas seen in *Triporoletes* Mtchedlishvili.

AFFINITY: Kuyl, Muller, and Waterbolk (1955), Potonié (1956), and others have demonstrated that the type and other Upper Cretaceous species are comparable to certain spores of *Hemitelia* R. Brown, a member of the Cyatheaceae. The Australian species, *K. lunaris*, shows slight resemblance to *Alsophila blechnoides* (Rich.) also of the Cyatheaceae (see Erdtman 1957; Fig. 79).

Kuylisporites lunaris Cookson & Dettmann 1958
(Pl. V, fig. 9-12)

DESCRIPTION: Microspores trilete, biconvex; amb subcircular, subtriangular, or subquadrangular with straight or convex sides. Laesurae straight, extending to equator, and bordered by weakly thickened lips (1-2 μ wide). Exine 1·5-2·5 μ thick, slightly thicker (2-3·5 μ) at the equator where a few widely-scattered, shallow foveolae occur; surface finely granulate to microreticulate under oil immersion (Pl. V, fig. 12). Conspicuous, crescentic-shaped elevations (scutula of Potonié 1956, p. 38), which delimit and partially enclose circular to elliptical, shallow lumina (3-8 μ in diameter), usually confined to distal surface. Central area of each contact face granulate and occasionally with small scutula. Total number of scutula observed on individual specimens varies from 3 to 25.

DIMENSIONS: Equatorial diameter 39 (48) 67 μ.

COMPARISON: The species is weakly thickened equatorially, and is not entirely conformable with *Kuylisporites*. *K. lunaris* Cookson & Dettmann is similar to *Brochotriletes degradatus* Verbitskaya, but has longer laesurae and a thicker equatorial exine. It is distinct from *K. waterbolki* Potonié, *K. mirabilis* (Bolkhovitina), and *K. separatus* (Chlonova), all of which have equatorially situated scutula and shorter laesurae.

DISTRIBUTION: The species shows wide lateral distribution, and appears to have some stratigraphical value in the Upper Mesozoic of SE. Australia (Cookson and Dettmann 1958b; Dettmann 1959; present study, Tables 4-9).

Infraturma MURORNATI Potonié & Kremp 1954

Azonate, acavate, trilete spores having simple or lipped apertures and a sculpture of elongated elevations or depressions are allocated to this infraturma. The sculptural elements include foveolae, lumina, muri, rugulae, etc.: the elevations, as seen in surface view, are at least twice as long as wide and may be coalescent.

The murornate spores of Pyrobolotriletes, Lagenotriletes, and Barbates conform with Murornati Potonié & Kremp. Spores attributed by Neves (1961) to his series, Pseudocingulati, appear to be comparable to the Infraturma Murornati.

Genus **Lycopodiacidites** Couper emend. Potonié 1956

1953 *Lycopodiacidites* Couper, p. 26.
1956 *Lycopodiacidites* Couper emend. Potonié, p. 39.
1961 *Iniquiornatisporis* Dev, p. 44.

REMARKS: This genus was emended by Potonié (1956) to incorporate trilete, azonate microspores having a subcircular amb and verrucate to rugulate sculpture distally. The Australian species described below has proximal sculpture, and is not strictly conformable, therefore, with *Lycopodiacidites* Couper.

Lycopodiacidites asperatus sp. nov.

(Pl. VI, fig. 1-3; Fig. 41)

DIAGNOSIS: Microspores trilete, spheroidal; amb circular to convexly subtriangular. Laesurae straight, length ¾ amb radius. Exine thick, coarsely rugulate; closely-spaced, sinuous rugulae 2-5 μ high, 2-3 μ in greatest basal diameter, and with broader (2-4 μ wide), truncated, granulate crests. Sculpture slightly reduced about laesurate margins.

DIMENSIONS: (inclusive of sculpture) Equatorial diameter 49 (60) 73 μ; polar diameter (7 specimens) 46 (51) 56 μ.

HOLOTYPE: Preparation D241/4 36·5 118·3 P22008; Pl. VI, fig. 1, 2. Proximal aspect. Amb circular, 51 μ in diameter; laesurae 20 μ long. Exine with sinuous rugulae which have granulate crests 2-3 μ wide.

LOCUS TYPICUS: South Australia, Kopperamanna Bore No. 1 at 2,970 ft.

COMPARISON: The species resembles *Camptotriletes clivosus* Bolkhovitina, but differs in having larger rugulae which are granulate. *Lycopodiacidites asperatus* sp. nov. is distinguishable from *Lygodioisporites perverrucatus* Couper, *Trilites verrucatus* Couper, *Dicksonia crocina* Bolkhovitina, and *Lophotriletes barbarus* Bolkhovitina in possessing rugulate, and not verrucate, sculpture.

The spores of *Botrychium palmatum* Presl. are similar to *Lycopodiacidites asperatus* (see Nakamura and Shibasaki 1959, p. 6; Pl. 3, fig. 10).

DISTRIBUTION: The species occurred sporadically in many of the samples examined (see Tables 3-9).

Genus **Tripartina** Maljavikina ex Potonié 1960

1949 *Tripartina* Maljavikina (pars), p. 48.
1960 *Tripartina* Maljavikina ex Potonié, p. 48.

TYPE SPECIES: *Tripartina variabilis* Maljavikina 1949.

REMARKS: Potonié (1960) validated and emended the genus which incorporates trilete microspores having a triangular amb and radially disposed sculptural elements. Morphologically similar spores had been assigned previously (Pflug in Thomson and Pflug 1953, Krutzsch 1959) to *Undulatisporites* Pflug, but the holotype of Pflug's genus is distinct from *Tripartina* Maljavikina ex Potonié in having a smooth exine (see Thomson and Pflug 1953, p. 52; Pl. 1, fig. 81: Potonié 1956, p. 19).

Tripartina cf. **T. variabilis** Maljavikina 1949

(Pl. V, fig. 13-15)

DESCRIPTION: Microspores trilete; amb concavely triangular with sharply pointed angles. Laesurae weakly sinuous, extending to amb, and accompanied by undulate lips 1-2 μ high and 3 μ wide. Exine 1·5-2 μ thick; distal surface with radially disposed, narrow, sinuous channels (lumina) which emanate from pole and which are separated by smooth intervening areas 2-3 μ wide. Proximal exine smooth.

DIMENSIONS: Equatorial diameter 28 (36) 50 μ.

COMPARISON: The Australian spores are similar to *Tripartina variabilis* Maljavikina and are distinct from *Undulatisporites pseudobrasiliensis* Krutzsch which has a 'fossulate' proximal exine and a straight-sided triangular amb.

DISTRIBUTION: The species was described from Middle Jurassic strata of the U.S.S.R. (Maljavikina 1949). The similar Australian form has been recovered from many of the samples investigated (see Tables 3-9).

Genus **Cyclosporites** Cookson & Dettmann 1959

1958 *Radiatisporites* Cookson & Dettmann, p. 103 non Potonié & Kremp 1954.
1959 *Cyclosporites* Cookson & Dettmann, p. 260.

TYPE SPECIES: *Cyclosporites hugesi* (Cookson & Dettmann) Cookson & Dettmann 1959.

REMARKS: The genus is distinct from *Tripartina* Maljavikina ex Potonié and *Tigrisporites* Klaus in having proximal, instead of distal, radially disposed sculptural elements.

Bolkhovitina's species, *Leiotriletes eximius* and *Lygodium reticulatiformis*, appear to be conformable with *Cyclosporites* Cookson & Dettmann.

Cyclosporites hughesi (Cookson & Dettmann) Cookson & Dettmann 1959

(Pl. VI, fig. 4-7)

1958 *Radiatisporites hughesi* Cookson & Dettmann, p. 103; Pl. 15, fig. 4-6.
1959 *Cyclosporites hughesi* (Cookson & Dettmann) Cookson & Dettmann, p. 260.

DESCRIPTION: Microspores trilete, biconvex; amb subcircular to convexly subtriangular. Laesurae straight, length ¾ spore radius; enclosed within membraneous, elevated (2-3 μ high) lips. Exine 1·5 μ thick; with an open-meshed reticulum composed of narrow (2 μ in basal diameter), sharply-crested, high (4-7 μ), elongated muri which are separated by lumina 5-6 μ wide. Proximal muri radially arranged, emanating from laesurate margins and bifurcating towards amb; distal muri sinuous, arranged obliquely or tangentially to amb.

DIMENSIONS: Equatorial diameter (including sculpture) 42 (52) 64 μ.

COMPARISON: *Leiotriletes eximius* Bolkhovitina and *Lygodium reticulatiformis* Bolkhovitina have radially arranged proximal muri, but both species are distinct from *Cyclosporites hughesi* (Cookson & Dettmann) in having wider and more closely spaced muri.

DISTRIBUTION: A widely distributed species in SE. Australia where it seems to have undoubted stratigraphical importance (Cookson and Dettmann 1958b; Dettmann 1959; present study, Tables 3, 4, 6-8).

Genus **Foveotriletes** van der Hammen ex Potonié 1956

TYPE SPECIES: *Foveotriletes scrobiculatus* (Ross) Potonié 1956.

Fovetriletes parviretus (Balme) comb. nov.

(Pl. VI, fig. 8-13)

1957 *Microreticulatisporites parviretus* Balme, p. 24-25; Pl. 4, fig. 50, 51.

DESCRIPTION: Microspores trilete, biconvex; amb triangular with straight to concave sides. Laesurae straight to sinuous, length ¾ spore radius, and occasionally with membraneous, elevated lips. Exine 2-3·5 μ thick, foveolate to foveo-reticulate; foveolae deep to shallow, irregular in outline, 0·5-2 μ in maximum diameter, and separated by smooth intervening areas.

DIMENSIONS: Equatorial diameter 45 (57) 67 μ.

REMARKS: Considerable variation in the diameter and depth of the foveolae exists among the spores which are assigned here to *Foveotriletes parviretus* (Balme), and which may well be corroded representatives of smooth-walled species, such as *Dictyophyllidites crenatus* sp. nov. In some specimens (Pl. VI, fig. 8-12) the foveolae are deep and closely spaced; other examples (Pl. VI, fig. 13) have shallow, imperceptible foveolae which are more widely spaced on an otherwise smooth exine. The lightly 'sculptured' specimens usually possess membraneous, laesurate lips and closely resemble *D. crenatus* which is of common occurrence in all the samples from which *F. parviretus* has been recovered.

COMPARISON: The species has a thinner exine and is smaller than *Foveotriletes microreticulatus* Couper; *Cybotiumidites mesopunctatus* Maljavikina is larger and has shorter laesurae. Corroded examples of *Cyathidites punctatus* (Delcourt & Sprumont) and *C. asper* (Bolkhovitina) differ from *F. parviretus* in having 'granulate sculpture'.

DISTRIBUTION: Balme (1957) described the species from Neocomian-Aptian deposits of Western Australia. In the present study it has only been isolated from samples in which *Dictyophyllidites crenatus* is also present (see Tables 3-9).

Genus **Foveosporites** Balme 1957

1957 *Foveosporites* Balme, p. 17.
1959 *Foveasporis* Krutzsch (pars), p. 162.

TYPE SPECIES: *Foveosporites canalis* Balme 1957.

OTHER SPECIES: The following Mesozoic and Tertiary species conform with *Foveosporites* Balme:

(1) *Foveosporites* (al. *Foveasporis*) *fovearis* (Krutzsch 1959, p. 163; Pl. 30, fig. 332, 333) comb. nov. Occurrence: Germany; Middle Eocene.
(2) *Foveosporites* (al. *Foveasporis*) *linearis* (Krutzsch 1959, p. 166; Pl. 31, fig. 343-45) comb. nov. Occurrence: Germany; Middle Eocene.
(3) *Foveosporites* (al. *Ophioglossum*) *senomanicum* (Chlonova 1960, p. 30; Pl. 3, fig. 13-15) comb. nov. Occurrence: Siberia; Cenomanian-Turonian.
(4) *Foveosporites* (al. *Foveotriletes*) *budejovicensis* (Pacltova 1961, p. 10; Pl. 6, fig. 1-3) comb. nov. Occurrence: Czechoslovakia; Senonian.
(5) *Foveosporites* (al. *Ophioglossum*) *fulvaster* (Bolkhovitina 1956, p. 63; Pl. 8, fig. 105a) comb. nov. Occurrence: Siberia; Upper Jurassic.
(6) *Foveosporites* (al. *Ophioglossum*) *fuscus* (Bolkhovitina 1956, p. 64; Pl. 8, fig. 107) comb. nov. Occurrence: Siberia; Lower Cretaceous.
(7) *Foveosporites* (al. *Ophioglossum*) *delectus* (Bolkhovitina 1956, p. 65; Pl. 8, fig. 108) comb. nov. Occurrence: Siberia; Lower Jurassic.
(8) *Foveosporites* (al. *Ophioglossum*) *multicavus* (Bolkhovitina 1956, p. 65; Pl. 8, fig. 109) comb. nov. Occurrence: Siberia; Lower Cretaceous.

COMPARISON AND AFFINITY: The genus, as defined by Balme (1957), is characterized by foveolate sculpture and a circular to convexly triangular amb. *Foveotriletes* van der Hammen ex Potonié is distinct in having a concavely triangular amb, and *Microreticulatisporites* (Knox) is readily distinguishable by its reticulate sculpture. *Microfoveolatisporis* Krutzsch may be comparable to *Foveosporites* Balme but the illustrations of the type species, *M. tuemmlitzensis* Krutzsch (1962, p. 58; Pl. 22, fig. 1-3), do not depict the sculptural features clearly.

Balme (1957) noted that the type species *Foveosporites canalis*, resembles the spores of the *Lycopodium verticillatum* group of Knox (1950).

Foveosporites canalis Balme 1957

(Pl. VI, fig. 14-17)

DESCRIPTION: Microspores trilete, biconvex; amb subcircular to convexly subtriangular. Laesurae straight, extending almost to equator, and with thin, low (1-2 μ high) lips. Exine 2 μ thick, foveolate; foveolae circular in outline, *c.* 1 μ in diameter, and spaced 3-4 μ apart. Proximal foveolae usually coalescent, occurring in groups of two to four.

DIMENSIONS: Equatorial diameter 34 (43) 53 μ.

COMPARISON: Except for their greater size, the SE. Australian specimens conform with Balme's (1957) diagnosis of *Foveosporites canalis*. The species shows some resemblance to *F. senomanicum* (Chlonova), *F. delectus* (Bolkhovitina), and *F. multicavus* (Bolkhovitina), but differs in its longer laesurae and coalescent proximal foveolae. *F. budejovicensis* (Pacltova) is distinct in having larger, discrete foveolae.

DISTRIBUTION: Balme (1957) described the species from Western Australia, where it occurs in Neocomian-Aptian deposits and has been recorded doubtfully from Oxfordian-Kimeridgian strata. Records made during the present study and previously (Dettmann 1959) indicate that it is widely distributed in the Upper Mesozoic of SE. Australia (see Tables 3-9).

Genus **Lycopodiumsporites** Thiergart ex Delcourt & Sprumont 1955

TYPE SPECIES: *Lycopodiumsporites agathoecus* (Potonié) Thiergart 1938.

REMARKS: Trilete, azonate microspores having distal reticulate sculpture and membraneous laesurate lips are here assigned to *Lycopodiumsporites* Thiergart ex

Delcourt & Sprumont. It is recognized that this genus is of insecure validity (see Krutzsch 1959, p. 159, 164; and cf. Manum 1962, p. 25; Delcourt et al. 1963, p. 286), and that its type species, *Lycopodiumsporites agathoecus* (Potonié), is now believed to be characterized by foveo-reticulate sculpture (loc. cit.). However, the institution of a new genus to accommodate the Australian species seems undesirable until *Lycopodiumsporites* and other morphologically related genera have received detailed revision.

Several of the species described herein are comparable to the spores found in certain modern *Lycopodium* species that are grouped into the *Lycopodium clavatum* group of Knox (1950) and Group IV of Harris, W. F. (1955).

Lycopodiumsporites austroclavatidites (Cookson) Potonié 1956

(Pl. VI, fig. 18-21)

1950 cf. *Lycopodium annotinum* L.; Reissinger, p. 103; Pl. 18, fig. 1.
1953 *Lycopodium austroclavatidites* Cookson, p. 469, Pl. 2, fig. 35.
1956 *Lycopodiumsporites austroclavatidites* (Cookson) Potonié, p. 46.
1956 *Lycopodium perplicatum* Bolkhovitina, p. 63; Pl. 8, fig. 104a-b.
1957 *Lycopodiumsporites* cf. *austroclavatidites* (Cookson) Potonié: Delcourt & Sprumont; Pl. 3, fig. 27.
1957 *Lycopodium austroclavatidites* Cookson: Balme, p. 16; Pl. 1, fig. 8.
1958 *Lycopodiumsporites clavatoides* Couper (pars), p. 132; Pl. 15, fig. 12, 13.
1958 *Lycopodiumsporites clavatoides* Couper: Lantz, p. 923; Pl. 2, fig. 18.
1958 *Lycopodium* cf. *magellanicum* Sw.: Verbitskaya; Pl. 1, fig. 9.
1959 *Lycopodiumsporites reticulumsporites* Rouse (pars), p. 309; Pl. 1, fig. 3.
1959 *Lycopodium mediocris* Bolkhovitina, p. 83; Pl. 1, fig. 5.
1960 *Lycopodium marginatum* Kara-Murza var. *rotunda* Kara-Murza; Pl. 16, fig. 2.
1961 non *Lycopodium* aff. *clavatum* L.: Chlonova, p. 39; Pl. 1, fig. 6.

DESCRIPTION: Microspores trilete, plano-convex, the distal surface strongly convex; amb subcircular to convexly subtriangular. Laesurae straight, length about ¾ spore radius; enclosed within membraneous, elevated (2-3 μ high) lips. Exine 1·5-2 μ thick; smooth proximally and reticulate both distally and equatorially. Perfect reticulum composed of narrow (*c.* 1 μ wide), projecting (2-3 μ high) muri which, in optical section, have straight to concave sides; lumina hexagonal to pentagonal in outline and 7-12 μ in diameter.

DIMENSIONS: (inclusive of sculpture) Equatorial diameter 34 (43) 58 μ; polar diameter (2 specimens) 32, 42 μ.

REMARKS: The species is characterized by a regular, coarse-meshed, perfect reticulum, the thin, projecting muri of which simulate a membraneous flange at the equator (cf. Couper 1958, p. 132).

Cookson (1953) and Couper (1958) noted that the species is comparable to the modern spores of the *Lycopodium clavatum* group of Knox (1950), and suggested a related origin of the fossil spores.

DISTRIBUTION: A widely-distributed species in Jurassic and Cretaceous sediments. It is common in the Upper Mesozoic of SE. Australia (see Tables 3-9).

Lycopodiumsporites circolumenus Cookson & Dettmann 1958

(Pl. VII, fig. 1-3)

DESCRIPTION: Microspores trilete, biconvex; amb convexly subtriangular to subcircular. Laesurae straight, approximating equator, and with narrow (*c.* 1 μ wide), elevated (2-5 μ high) lips. Exine 2-3 μ thick; proximal surface smooth, except in the central area of each contact face where a cluster of two to four, small verrucae or rugulae are developed. Distal exine with a regular reticulum composed of low (2 μ high), anastomosing muri which have narrow (1-2 μ wide), straight sides and broader (2-3 μ), flat-topped crests. Lumina circular to polygonal in outline and 4-7 μ in diameter.

DIMENSIONS: Equatorial diameter (inclusive of sculpture) 34 (45) 62 μ.

COMPARISON: The species is distinct from *Lycopodiumsporites austroclavatidites* (Cookson) in having wider muri and more rounded lumina. *Dictyotriletes southeyensis* Pocock has a larger meshed, imperfect reticulum.

The species does not exactly correspond with any of the modern *Lycopodium* spores described by Knox (1950), Harris, W. F. (1955), and Erdtman (1957).

DISTRIBUTION: Although never common, the species shows widespread lateral distribution in SE. Australia (Cookson and Dettmann 1958b; Dettmann 1959; present study, Tables 3-8). It is known also from Upper Jurassic and Aptian sediments of Western Australia (Cookson and Dettmann 1958b).

Lycopodiumsporites reticulumsporites (Rouse) comb. nov.

(Pl. VII, fig. 4-7)

1958 *Lycopodiumsporites clavatoides* Couper: Lantz, p. 923; Pl. 2, fig. 17.
1959 *Lycopodium reticulumsporites* Rouse (pars), p. 309; Pl. 2, fig. 1, 2 (holotype).
1962 non *Lycopodiumsporites austroclavatidites* (Cookson): Pocock, p. 33; Pl. 1, fig. 5-6.

DESCRIPTION: Microspores trilete, biconvex; amb subcircular to convexly triangular. Laesurae indistinct, straight, length ⅔ spore radius; with membraneous, elevated (*c.* 1 μ high) lips. Exine *c.* 1 μ thick, reticulate. Distal and equatorial reticulum composed of narrow (less than 1 μ wide), low (*c.* 1 μ high), straight-sided muri which usually coalesce to enclose hexagonal or pentagonal lumina 2-6 μ in diameter. Proximal surface with reduced sculpture of low, narrow, elongate muri which terminate freely or anastomose to enclose rectilinear lumina 7 μ in maximum length.

DIMENSIONS: Equatorial diameter (including sculpture) 25 (31) 39 μ.

COMPARISON: The species may be conspecific with *Lycopodium parvireticulatum* (Naumova), L. cf. *clavatum* L. (Verbitskaya 1958; Pl. 1, fig. 4: 1962; Pl. 1, fig. 4a, b), and *Lycopodium* sp. (Reissinger 1950; Pl. 12, fig. 27), but the proximal sculpture of these spores has not been described. *Lycopodiumsporites reticulumsporites* is distinct from *L. austroclavatidites* (Cookson) f. *tenuis* Balme and *L. rosewoodensis* de Jersey in showing proximal sculpture. It is distinct also from *Retitriletes globosus* Pierce which has a coarser meshed reticulum.

The species resembles the modern spores of *Lycopodium annotonium* L., *L. obscura* L., and *L. sprucei* Baker (see Knox 1950).

DISTRIBUTION: Previously recorded from the Bathonian of England (Lantz 1958b) and from probable Upper Jurassic strata of Canada (Rouse 1959). The species was recovered from most of the Australian samples examined, and was common in those from E. Victoria (see Tables 3-9).

Lycopodiumsporites eminulus sp. nov.

(Pl. VII, fig. 8-12)

1960 *Lycopodium* aff. *clavatum* L.: Chlonova, p. 28; Pl. 3, fig. 7.

DIAGNOSIS: Microspores trilete; amb subcircular to convexly subtriangular; proximal surface pyramidal, distal surface convex. Laesurae straight, length ¾ spore radius; enclosed within narrow (1-2 μ wide), elevated (1-2 μ high) lips. Exine 2 μ thick, smooth proximally, and with a perfect, regular reticulum distally. Muri membraneous, 1-2 μ high; with straight sides and expanded, flat-topped crests. Lumina subcircular to polygonal in outline and 2-6 μ in diameter.

DIMENSIONS: (including sculpture) Equatorial diameter 28 (37) 49 μ; polar diameter (1 specimen) 34 μ.

HOLOTYPE: Preparation D141/1 38·9 121·4 P21964; Pl. VII, fig. 11, 12. Distal aspect. Amb subcircular, 31 μ in diameter. Laesurae 11 μ long. Exine 2 μ thick, smooth proximally, and reticulate distally. Muri 1-2 μ high; lumina 2-5 μ in diameter.

LOCUS TYPICUS: Victoria, Wonthaggi State Coal Mine Area; No. 20 shaft, bottom seam 1 E. (SE. dip); sample P22593.

COMPARISON: The species may be conspecific with the spores figured by Weyland and Greifeld (1953, p. 41; Pl. 10, fig. 41, 43, 47) of *Reticulatisporites potoniei* Pflug & Thomson. *Lycopodiumsporites eminulus* sp. nov. is distinguishable from *L. austroclavatidites* (Cookson) in having smaller lumina, lower muri, and wider lips; and from *L. reticulumsporites* (Rouse) in its higher muri and smooth proximal exine. It is distinct also from *L. gracilis* Nilsson which has a thinner exine and inconspicuous lips, and *Lycopodium* aff. *undulatum* L. (in Bolkhovitina 1959, p. 82; Pl. 1, fig. 4) which shows wider muri.

Lycopodiumsporites eminulus resembles the spores found in living *Lycopodium paniculatum* Desv. (see Knox 1950).

DISTRIBUTION: The specimens described by Chlonova (1960) are from the Upper Cretaceous of Siberia. The species is widely distributed in SE. Australia, and is common in the stratigraphically lower sediments examined from the Otway Basin and E. Victoria (see Tables 3-9).

Lycopodiumsporites nodosus sp. nov.

(Pl. VII, fig. 13-16)

DIAGNOSIS: Microspores trilete; amb convexly subtriangular to circular; distal surface convex, proximal surface pyramidal. Laesurae straight, length ¾ spore radius; enclosed within membraneous, elevated (2-3 μ high) lips. Exine 2·5-3·5 μ thick, coarsely granulate overall, and reticulate both distally and equatorially. Regular reticulum composed of narrow (1-2 μ wide), straight-sided, granulate muri (3-5 μ high) which enclose polygonal lumina 6-12 μ in diameter. Granules smaller and more widely spaced on proximal surface where two to three, narrow, low, freely terminating muri are usually developed.

DIMENSIONS: Equatorial diameter (including sculpture) 42 (50) 62 μ.

HOLOTYPE: Preparation D276/1 26·9 118·7 P22018; Pl. VII, fig. 13, 14. Proximal aspect. Amb subcircular, 53 μ in diameter. Laesurae 22 μ long. Exine 2·5 μ thick; muri 4 μ high, 1 μ wide; lumina 6-12 μ in diameter.

LOCUS TYPICUS: South Australia, Penola Bore No. 1 at 3,850-55 ft.

COMPARISON: This distinctive species is readily distinguishable from other SE. Australian representatives of *Lycopodiumsporites* in having coarsely granulate sculpture.

DISTRIBUTION: The species is of common occurrence and shows wide distribution in the sediments examined from the Upper Mesozoic of SE. Australia (see Tables 3-9).

Lycopodiumsporites facetus sp. nov.

(Pl. VII, fig. 17-22)

DIAGNOSIS: Microspores trilete, biconvex; amb subcircular to circular. Laesurae straight, extending almost to periphery, and with membrancous lips *c.* 1 μ high. Exine 3-4·5 μ thick, two-layered; consisting of a thin (*c.* 1 μ thick) intexine and a thicker (2-3 μ) sculptured exoexine which is composed of randomly arranged granules. Exoexine both finely granulate and reticulate overall. Perfect reticulum with high (5-8 μ), straight-sided, membrancous muri which enclose subcircular to polygonal lumina (7-17 μ in diameter) distally; proximal muri enclose radially arranged, rectangular lumina 17 μ in maximum diameter.

DIMENSIONS: Equatorial diameter (including sculpture) 53 (68) 83 μ.

HOLOTYPE: Preparation D139/2 24·6 110·2 P21984; Pl. VII, fig. 17-20. Proximal aspect. Amb subcircular, 65 μ in diameter; laesurae 24 μ long. Exine 3 μ thick; exoexine finely granulate, and with mebraneous muri (5-7 μ high) which enclose polygonal lumina distally and rectangular lumina proximally; lumina 7-17 μ in diameter.

LOCUS TYPICUS: Victoria, Wonthaggi State Coal Mine Area; Kirrak Area, coal in W. heading (41^2); sample P22599.

COMPARISON: The species has a closed-meshed reticulum; therefore it does not conform with *Cyclosporites* Cookson & Dettmann. *Lycopodiumsporites facetus* sp. nov. resembles *Reticulatisporites castellatus* Pocock, but differs in having smaller lumina, lower muri, and clearly defined laesurae. *Peromonolites reticulatus* Lantz has smaller lumina and a monolete aperture, whilst *Lycopodiumsporites nodosus* sp. nov. lacks proximal reticulate sculpture.

DISTRIBUTION: The species is of infrequent occurrence, and is widely distributed in the sediments examined from the Upper Mesozoic of SE. Australia (see Tables 3-8).

Genus **Reticulatisporites** Ibrahim emend. Potonié & Kremp 1954

TYPE SPECIES: *Reticulatisporites reticulatus* Ibrahim 1933.

Reticulatisporites pudens Balme 1957

(Pl. VII, fig. 23-26)

DESCRIPTION: Microspores trilete, biconvex; amb subcircular to convexly triangular. Laesurae straight, simple, length ¾ spore radius. Exine 2-3 μ thick, smooth proximally, and reticulate distally. Reticulum with low (1-2 μ high), rounded muri (2-4 μ wide) and subcircular to irregular lumina 1-5 μ in maximum diameter.

DIMENSIONS: Equatorial diameter (including sculpture) 20 (28) 34 μ.

REMARKS: The SE. Australian specimens conform with the original diagnosis except that they are larger in size.

DISTRIBUTION: Balme (1957) described the species from Neocomian-Aptian sediments of Western Australia. It ocurs frequently in many of the samples examined from SE. Australia (Dettmann 1959; present study, Tables 3-9).

Genus **Klukisporites** Couper 1958

TYPE SPECIES: *Klukisporites variegatus* Couper 1958.

REMARKS: This genus incorporates trilete, distally foveoreticulate microspores, some of which are attributable also to the mutually overlapping genera, *Reticuli-*

sporites Potonié & Kremp, *Lycopodiumsporites* Thiergart ex Delcourt & Sprumont, *Dictyotriletes* Naumova, and *Reticulatisporites* Ibrahim. Nevertheless, the type species *Klukisporites variegatus* Couper, is morphologically distinct from all these genera in having coarse foveo-reticulate sculpture distally together with proximal granules or verrucae. Comparable features are exhibited by the Australian microspores here assigned to *Klukisporites* Couper.

Ischyosporites Balme differs from *Klukisporites* in having a valvate exine.

AFFINITY: Couper (1958) has demonstrated that the type species closely resembles the microspores found in the schizaeaceous species, *Klukia exilis* (Phillips) and *Stachypteris hallei* Thomas. Comparable spores have been described by Harris, T. M. (1961, p. 137) from the closely related species *S. spicans* Pomel.

Klukisporites scaberis (Cookson & Dettmann) comb. nov.

(Pl. VIII, fig. 1-7)

1958 *Ischyosporites scaberis* Cookson & Dettman, p. 104; Pl. 15, fig. 7-9.

DESCRIPTION: Microspores trilete, biconvex; amb subcircular to convexly triangular. Laesurae straight, extending almost to amb, and encompassed by thickened, granulate to verrucate lips 2-3 μ wide. Exine one-layered, 2-3 μ thick (exclusive of sculpture); with granulate sculpture overall and reticulate sculpture distally. Distal reticulum composed of low (2-3 μ high), wide (5-8 μ), usually anastomosing muri and subcircular to polygonal lumina 4-10 μ in diameter. Proximal granules coarse, closely spaced; distal granules smaller and confined to bases of lumina.

DIMENSIONS: Equatorial diameter 39 (51) 64 μ; polar diameter (2 specimens) 34μ, 39 μ.

COMPARISON: *Klukisporites scaberis* (Cookson & Dettmann) is closely similar to *K. variegatus* Couper and the spores of both *Stachypteris spicans* Pomel and *Klukia exilis* (Phillips). However, the Australian spores are distinguishable in their smaller size and more rounded lumina, which are granulate, together with the absence of membraneous laesurate lips (raised commissures of Couper 1958). *K. scaberis* also is distinct from *K. visibilis* (Bolkhovitina) which has a triangular amb and lacks granulate lumina; *Dictyotriletes granulatus* Pocock has considerably narrower granulate muri.

DISTRIBUTION: The species is widely distributed in the Upper Mesozoic of SE. Australia (Cookson and Dettmann 1958b, 1959a; Dettmann 1959; present study, Tables 3-9), and it is a common element in samples examined from E. Victoria and the Otway Basin.

Genus **Dictyotosporites** Cookson & Dettmann 1958

RESTATED DIAGNOSIS: Microspores trilete. Exine with a surface reticulum composed of the terminal branches of, and supported on the columns of, discrete or coalescent, branched elevations.

TYPE SPECIES: *Dictyotosporites speciosus* Cookson & Dettmann 1958.

REMARKS: Cookson and Dettmann (1958b) defined the genus to accommodate trilete microspores having a sculpture of two or more superimposed reticula. Microtome sections of the type species confirm that the muri of the open-meshed primary reticulum bifurcate towards their crests, and that the bifurcations anastomose to form the secondary reticulum. Similar sculptural features are exhibited by *Dictyotosporites complex* Cookson & Dettmann and *D. filosus* sp. nov., except that the primary sculptural elements are discrete capilli and not coalescent muri.

Distyotosporites speciosus Cookson & Dettmann 1958

(Pl. VIII, fig. 8-14)

DESCRIPTION: Microspores trilete, plano-convex, the distal surface convex; amb roundly triangular to subcircular. Laesurae straight, simple, approximating amb. Exine 2 μ thick (5-10 μ thick inclusive of sculpture) one-layered, homogeneous in structure; sculpture of two superimposed reticula. Primary, imperfect reticulum consists of polygonal lumina 5-10 μ in diameter and anastomosing or freely terminating muri (3-8 μ high, 2-3 μ basal diameter) which taper towards their crests where they bifurcate. Bifurcations form narrow, low, anastomosing muri of the lace-like secondary reticulum the shallow, polygonal lumina of which are 1-3 μ in diameter.

DIMENSIONS: Overall equatorial diameter 42 (56) 73 μ.

COMPARISON: The species appears to be distinct from other Mesozoic spores described in the available literature. Some of the microspores borne by *Hemionitis* L., for example those of *H. arifolia* (Burm.) (see Erdtmann 1957; Fig. 111), show bifurcating sculptural elevations but these do not anastomose to form superimposed reticula.

DISTRIBUTION: Widely distributed in the Upper Mesozoic of SE. Australia where it appears to be of undoubted stratigraphical importance (see Cookson and Dettmann 1958b; Dettmann 1959; present study, Tables 4-8).

Dictyotosporites complex Cookson & Dettmann 1958

(Pl. IX, fig. 1-7)

1958 *Dictyotosporites complex* Cookson & Dettmann (pars), p. 107; Pl. 16, fig. 11, 15, 16.
1958 *Dictyotosporites* cf. *complex* Cookson & Dettmann, p. 107; Pl. 16, fig. 12, 13.

DESCRIPTION: Microspores trilete, plano-convex, the distal surface strongly convex; amb circular to subcircular in uncompressed specimens and irregular in flattened specimens. Exine one-layered, 1-1·5 μ thick; with a surface reticulum composed of the terminal branches of, and supported on the columns of, thread-like capilli. Capilli 3-5 μ high, *c.* 1 μ in basal diameter; terminal branches anastomose to enclose polygonal to circular lumina 1-3 μ in diameter. Laesurae indistinct, straight or slightly sinuous, length ½ spore radius, and with thin, low (*c.* 1 μ high) lips.

DIMENSIONS: Equatorial diameter; overall 42 (51) 63 μ, exclusive of sculpture 32 (38) 44 μ.

HOLOTYPE: P17619. Cookson and Dettmann 1958b; Pl. 16, fig. 11: present study; Pl. IX, fig. 1, 2. Distal aspect. Amb irregular, 59 μ in maximum diameter; laesurae weakly sinuous, 14 μ long. Exine 1·5 μ thick, capilli *c.* 1 μ in basal diameter, 3-5 μ high, and with short terminal branches. Surface reticulum composed of narrow, anastomosing muri and polygonal to circular lumina 1-3 μ in diameter.

LOCUS TYPICUS: South Australia, Robe Bore No. 1 at 3,860 ft.

REMARKS AND COMPARISON: The bifurcating exinous processes (capilli) which support and form the surface reticulum of the one-layered exine are not represented in one of the specimens depicted by Cookson and Dettmann (1958b; Pl. 18, fig. 1). This spore is comparable to *Densoisporites velatus* Weyland & Krieger which has a stratified, cavate exine. *Dictyotosporites complex* Cookson & Dettmann differs from *D. speciosus* Cookson & Dettmann in having thread-like, primary sculptural elevations.

DISTRIBUTION: The species is now known to have wide distribution, both laterally and vertically, in the Upper Mesozoic of SE. Australia (see Cookson and Dettmann 1958b; Dettmann 1959; present study, Tables 3-8). It has been recorded also from probable uppermost Jurassic strata of Western Australia (Cookson and Dettmann 1958b).

Dictyotosporites filosus sp. nov.

(Pl. VIII, fig. 15-20)

DIAGNOSIS: Microspores trilete, plano-convex, the distal surface strongly arched; amb subcircular to convexly subtriangular. Laesurae straight, simple, length ¾ spore radius. Exine 1·5 μ thick (3-4 μ thick inclusive of sculpture); primary sculptural elements include tightly-packed, low (1 μ high), narrow (1 μ basal diameter) capilli. Terminal branches of capilli anastomose to form narrow, sinuous muri which enclose polygonal lumina 2-5 μ in diameter; distal lumina characteristically pentagonal or hexagonal in outline.

DIMENSIONS: Overall equatorial diameter (18 specimens) 48 (53) 62 μ; polar diameter (1 specimen) 45 μ.

HOLOTYPE: Preparation D346/9 31·2 121·6 P22029; Pl. VIII, fig. 15-17. Proximal aspect. Amb 51 μ in diameter; laesurae straight, 20 μ long. Exine 4 μ thick (inclusive of sculpture).

LOCUS TYPICUS: South Australia, Penola Bore No. 1 at 3,180-90 ft.

COMPARISON: The species differs from *Dictyotosporites speciosus* Cookson & Dettmann and *D. complex* Cookson & Dettmann in having a coarser-meshed secondary reticulum and shorter primary capilli.

DISTRIBUTION: Of infrequent occurrence in certain horizons of the Great Artesian, Murray, and Otway Basins and in E. Victoria (see Tables 4-8).

Genus **Januasporites** Pocock 1962

TYPE SPECIES: *Januasporites reticularis* Pocock 1962.

REMARKS: The genus, as diagnosed by Pocock (1962, p. 56), includes alete, distally 'porate' microspores having a membraneous, reticulate outer layer. Australian specimens here allocated to the genus are inconspicuously trilete and lack a 'distal pore', but they appear to be similar, if not identical, to the illustrated specimen of the type species. Cretaceous microspores assigned to *Woodsia reticulata* Bolkhovitina also may be comparable to *Januasporites* Pocock.

Januasporites spinulosus sp. nov.

(Pl. X, fig. 17-20)

DIAGNOSIS: Microspores trilete, biconvex; amb subcircular. Laesurae indistinct, straight, extending to amb of spore cavity. Sclerine two-layered; inner layer 1·5-2 μ thick, scabrate. Enveloping outer layer membraneous, reticulate distally, and spinulose proximally. Distal reticulum composed of high (8-11 μ), membraneous muri, which usually have serrate crests, and pentagonal or hexagonal lumina 11-14 μ in diameter. Proximal spinules *c.* 1 μ high, 1 μ in basal diameter, and spaced 2-3 μ apart except at laesurate margins where they are coalescent.

DIMENSIONS: Equatorial diameter; overall 50 (63) 78 μ, spore cavity 42 (52) 62 μ. Polar diameter (1 specimen) 39 μ.

HOLOTYPE: Preparation D289/43 39·5 117·8 P22045; Pl. X, fig. 17-19. Distal aspect. Amb subcircular, 73 μ in diameter; spore cavity 53 μ in diameter. Laesurae 25 μ long. Distal muri 11 μ high; lumina 14 μ in diameter. Scabrate inner layer 2 μ thick.

LOCUS TYPICUS: South Australia, Cootabarlow Bore No. 2 at 1,376-77 ft.

COMPARISON: As noted above, the species shows a striking resemblanee to *Januasporites reticularis* Pocock. *Woodsia reticulata* Bolkhovitina is distinct in its eoarser-meshed reticulum.

DISTRIBUTION: Recovered from several samples of the Otway and Great Artesian Basins (see Tables 4-7, 9).

Genus **Staplinisporites** Pocock 1962

TYPE SPECIES: *Staplinisporites caminus* (Balme) Pocock 1962.

REMARKS: Pocock's (1962) diagnosis of the genus conforms with the acingulate holotype and paratype of *Staplinisporites caminus* (Balme). However, as noted subsequently, the illustrated Canadian specimens which Pocock (1962) assigned to the species have equatorial thiekenings (interradial crassitudes), and are distinct from *Staplinisporites* Poeoek.

COMPARISON: The genus is charaeterized by both radially and eoncentrieally arranged distal elevations (or thickenings). It differs, therefore, from *Neochomotriletes* Reinhardt, *Taurocusporites* Stover, *Distalanulisporites* Klaus, and *Annulispora* de Jersey, all of which have circumpolar elevations only on the distal hemisphere; and from *Tigrisporites* Klaus which has radially disposed rugulae only on the distal surface.

Selaginella multiradiata Verbitskaya and *Euryzonotrilites microdiscus* var. *fimbriata* Kara-Murza almost certainly are identical to the genus. *Striatriletes coronarius* shows some resemblance to *Staplinisporites*, but, according to the diagnosis (Pierce 1961, p. 32), it is distinet in having an 'equatorial flange'.

The spores of the modern bryophyte species, *Encalypta ciliata* Hedw. resemble *Staplinisporites* (see Erdtman 1957; Fig. 210B).

Staplinisporites caminus (Balme) Pocock 1962

(Pl. IX, fig. 8, 9)

1957 *Cingulatisporites caminus* Balme, p. 27; Pl. 5, fig. 62, 63.
1958 *Cingulatisporites* cf. *caminus* Balme: Lantz, p. 924; Pl. 3, fig. 29.
1962 non *Staplinisporites caminus* (Balme) Pocock, p. 49; Pl. 5, fig. 87; Pl. 6, fig. 88-90.

DIAGNOSIS: Mierospores trilete, plano-convex, the distal surface convex; amb convexly triangular to subcircular. Laesurae straight or weakly sinuous, extending to amb, and with thin (*c.* 1 μ thick), low lips. Exine 2 μ thick, smooth or faintly granulate proximally. Equatorial region of distal surface with low (*c.* 1 μ high), radially disposed elevations whieh extend from equator to a narrow, low, circumpolar ridge; ridge concentric with, and $\frac{2}{3}$ radius of, amb. Distal exine enelosed within circumpolar ridge faintly granulate and thickened in a circular area (8-10 μ in diameter) about the pole.

DIMENSIONS: Equatorial diameter (2 specimens) 39 μ, 45 μ.

REMARKS: Although Pocock (1962) recognized that *Staplinisporites caminus* (Balme) is aeingulate, the illustrated Canadian speeimens whieh he equated to the species have equatorial thickenings (interradial crassitudes). Moreover, the Canadian spores show radially disposed elevations on the distal area bound by the polar and circumpolar thickenings, and are comparable to *Coronatispora valdensis* (Couper).

COMPARISON: The species is similar, and may be identical, to *Selaginella multiradiata* Verbitskaya. *Euryzonotriletes microdiscus* var. *fimbriata* was figured, but not described, by Kara-Murza (1960; Pl. 1, fig. 10); therefore, a more precise comparison is precluded. *Leiotriletes incertus* Bolkhovitina does not have a distal, circumpolar ridge.

DISTRIBUTION: Balme (1957) described the species from Western Australia where it occurs in Oxfordian-Kimeridgian strata, and is doubtfully known from Neocomian-Aptian deposits. Lantz's (1958b) subsequent record is from the Corallian of England, and the similar spores described by Verbitskaya (1958, 1962) are from Hauterivian-Barremian strata of Russia. Two specimens of *Staplinisporites caminus* have been recovered in the present investigation (see Tables 4, 6, 7).

Genus **Cicatricosisporites** Potonié & Gelletich 1933

1933 *Cicatricosisporites* Potonié & Gelletich, p. 522.
1949 *Trilaterina* Maljavikina, p. 48.
1950 *Mohrioidites* Thiergart, p. 84.
1951 *Mohrioisporites* Potonié, p. 114.
1955 *Liratosporites* Vishnu-Mittre, p. 119.
1961 *Mohria* Swartz: Markova (pars) in Samoilovitch et al., p. 84.

TYPE SPECIES: *Cicatricosisporites dorogensis* Potonié & Gelletich 1933.

Microspores referable to *Cicatricosisporites* Potonié & Gelletich have been reported widely from Upper Mesozoic and Tertiary sediments, and are comparable morphologically to some of the spores found in the Schizaeaceae. They are characterized by distal and equatorial sculpture of more or less parallel muri. In the type species, three series of parallel muri are arranged about a centre on the distal hemisphere and at an angle to the equator; the equatorial muri terminate in the proximo-equatorial, radial regions where they coalesce with adjacent muri of the same series (see Potonié 1951; Pl. 20, fig. 14; Kedves 1960; Pl. 4, fig. 14; Kedves 1961; Pl. 5, fig. 4). Similar sculptural features (particularly in the arrangement of the proximal terminations of the muri (see Fig. 4p)) are exhibited by *Cicatricosisporites australiensis* (Cookson), *C. ludbrooki* sp. nov., and the spores of *Ruffordia goepperti* (Dunk).

Distinct sculpturing is shown by the other *sporae dispersae* which are herein assigned to *Cicatricosisporites*, and which resemble some modern spores of *Anemia* Swartz (e.g., *A. jaliscana* Maxon and *A. dregeana* Kunze). The muri of these spores all terminate along the amb-angle bisectors where they fuse with alternate muri of neighbouring mural series (Fig. 4r). The terminations of the equatorial muri (as seen in spores situated in full polar aspect) simulate radial exinal thickenings, and the spores appear to be comparable to *Plicatella* Maljavikina ex Potonié and *Appendicisporites* Weyland & Krieger. The type species of these two genera are clearly distinct from *Cicatricosisporites*, however, in that their equatorial muri fuse, one with another, and form one only, projecting appendix in each equatorial, radial region.

The four species recovered from the SE. Australian deposits show radial symmetry, and their muri parallel the interradial margins of the amb. Following Delcourt and Sprumont (1955) and Kedves (1961), the criteria used in the distinction of the species include: shape of muri, both in optical section and surface view; width of four adjacent muri and lumina in distal, interradial regions;

relative width of muri and lumina; arrangement of muri; length of laesurae; and shape of amb. As far as it has been possible, all these features are detailed in the photographs which accompany the specific descriptions.

Cicatricosisporites australiensis (Cookson) Potonié 1956

(Pl. IX, fig. 10-16; Fig. 4p)

1953 *Mohrioisporites australiensis* Cookson, p. 470; Pl. 2, fig. 29-34.
1955 *Liratosporites* Type 1 Vishnu-Mittre, p. 119; Pl. 1, fig. 14, 15.
1956 *Cicatricosisporites australiensis* (Cookson) Potonié, p. 48.
1958 *Cicatricosisporites mohrioides* Delcourt & Sprumont: Lantz, p. 923; Pl. 2, fig. 19, 20.
1961 *Ruffordia goepperti* Seward: Bolkhovitina, p. 13, Pl. 1, fig. 9c-e.
1961 *Cicatricosisporites dorogensis* Potonié & Gelletich: Bolkhovitina, p. 70; Pl. 20, fig. 3a-c; Pl. 21, fig. 2d, e.
1962 *Cicatricosisporites dorogensis* Potonié & Gelletich: Pocock, p. 39; Pl. 2, fig. 36.

DESCRIPTION: Microspores trilete, tetrahedral, radially symmetrical; amb triangular, with straight to weakly convex or concave sides and notched angles. Laesurae straight, length ¾ of, to almost equal to, spore radius; enclosed within membraneous, elevated (2-3 μ high), sometimes undulating lips. Exine 1-2 μ thick, smooth on contact areas. Distal and equatorial exine with three series of narrow, low (1-2 μ high), occasionally bifurcating, sharply crested muri; each mural series consists of seven to twelve muri which are orientated parallel both to each other and to interradial sides of amb. Distal muri terminate along amb-angle bisectors where they coalesce with corresponding muri of neighbouring series; equatorial muri converge on to proximo-equatorial, radial regions where they coalesce with adjacent muri of the same series. Muri 1·5-2·5 μ wide, mostly wider than intervening lumina (1-2·5 μ wide); four adjacent muri and lumina total 9-12 μ in width.

DIMENSIONS: Equatorial diameter 36 (51) 70 μ; polar diameter (10 specimens) 39 (45) 50 μ.

REMARKS AND COMPARISON: The specimens isolated during the present study broaden the size range of the species. The orientation and size of sculptural elements, the characteristically notched outline of amb angles, and the smooth contact areas distinguish *Cicatricosisporites australiensis* (Cookson) from other concisely defined members of the genus. It resembles *C. goepperti* Groot & Penny and the spores of *Ruffordia goepperti* (Dunk.) (see Couper 1958, p. 109; Pl. 17, fig. 4-6), but differs in having wider and more closely-spaced muri and in the total width of four muri and lumina. *C. mohrioides* Delcourt & Sprumont has wider muri, and *C. dorogensis* (Potonié & Gelletich) is distinct in its shorter laesurae, subcircular amb, and arrangement of muri.

DISTRIBUTION: *C. australienses* is of widespread distribution in the Upper Mesozoic of SE. Australia (see Tables 3-9), and has been recovered previously from both Lower and Upper Cretaceous sediments in this area (Cookson 1953, 1954; Baker and Cookson 1955; Cookson and Dettmann 1958b, 1959a; Dettmann 1959). It is known also from the Lower Cretaceous of Western Australia (Balme 1957) and Queensland and New Guinea (Cookson and Dettmann 1958b), but has not been reported from definite Jurassic strata in Australasia. The extra-Australasian specimens illustrated by Vishnu-Mittre (1955), Lantz (1958b), Bolkhovitina (1961), and Pocock (1962) are from Neocomian (see Arkell 1956, p. 383) of India, uppermost Purbeck of England, Albian of Kazachstan, and Aptian-Lower Albian of Canada respectively.

Cicatricosisporites ludbrooki sp. nov.

(Pl. IX, fig. 17-22)

DIAGNOSIS: Microspores trilete, radially symmetrical, tetrahedral; amb triangular with straight to weakly convex sides and notched angles. Laesurae straight, length ¾ spore radius; lips membraneous, 2-4 μ high. Exine 2 μ thick, with distal and equatorial muri which are arranged in three series; six to nine, occasionally bifurcating, sharply-crested (2·5-3 μ high) muri of each series parallel both each other and interradial margins of triangular amb. Distal muri terminate along amb-angle bisectors where they coalesce with corresponding muri of neighbouring series; equatorial muri converge on to proximo-equatorial, radial regions where they terminate and coalesce with adjacent muri of the same series. Muri 2·5-3·5 μ wide, wider than intervening lumina (1-2 μ); four adjacent muri and lumina total 17-19 μ in width. Contact areas smooth or each with considerably reduced sculpture of four to five, low, narrow (1-2 μ wide), inconspicuous, parallel muri which are disposed at right angles to, and coalesce with, equatorial muri.

DIMENSIONS: Equatorial diameter (20 specimens) 56 (73) 96 μ; polar diameter (1 specimen) 42 μ.

HOLOTYPE: Preparation D346/1 40·3 110·9 P22037; Pl. IX, fig. 17, 18. Proximal aspect. Amb triangular, 67 μ in diameter. Laesurae 24 μ long; lips 2 μ high. Distal and equatorial muri 2·5-3 μ high, 2-3 μ wide, and spaced 1-2 μ apart in three series of nine; four adjacent muri and lumina total 17 μ in width. Proximal muri 2 μ wide.

LOCUS TYPICUS: South Australia, Penola Bore No. 1 at 2,790-98 ft.

COMPARISON: The species is similar to *Cicatricosisporites australiensis* (Cookson) in the arrangement of distal and equatorial muri, but differs in its larger size, wider muri (and total width of four adjacent muri and lumina), and proximal sculpture. It may be conspecific with the spores (*Mohria*-Typ.) which Thiergart (1949, p. 22; Pl. 4, fig. 15, 16) described and illustrated, and which Delcourt and Sprumont (1955) included within their species *C. mohrioides*. The latter species is distinct from *C. ludbrook*i sp. nov., however, in its narrower muri (in the holotype four muri and lumina total 14 μ in width), smaller size, and orientation of the muri on the contact areas. The spores assigned to *Anemia tricostata* Bolkhovitina by Markova (in Samoilovitch et al. 1961, p. 70; Pl. 17, fig. 6a-e) resemble *C. ludbrooki* but are smaller in size and have narrower muri which terminate freely in equatorial, radial regions.

DISTRIBUTION: In certain horizons of the Otway and Great Artesian Basins and E. Victoria (see Tables 4-8). The similar spores figured by Thiergart (1949) are from the Wealden of Germany.

Cicatricosisporites pseudotripartitus (Bolkhovitina) comb. nov.

(Pl. X, fig. 1-5)

1961 *Anemia pseudotripartita* Bolkhovitina, p. 53; Pl. 15, fig. 3a-c.
1961 *Anemia tripartita* Bolkhovitina: Markova in Samoilovitch et al., p. 69; Pl. 17, fig. 4.

DESCRIPTION: Microspores trilete, radially symmetrical, tetrahedral; amb triangular with straight to weakly convex sides and rounded angles. Laesurae straight, extending almost to amb, and with membraneous, elevated (2-3 μ high) lips. Exine 2 μ thick; sculptured distally and equatorially with three series of four to five, weakly sinuous, low (1-2 μ high), broadly rounded muri; muri of each series parallel both each other and interradial sides of triangular amb, and terminate along amb-angle bisectors where they coalesce with alternate muri of neighbouring series. Muri wider (3·5-4·5 μ) than intervening lumina (*c.* 1 μ wide); four adjacent muri and lumina total 21-23 μ in width. Proximal exine has considerably reduced sculpture of two to three, inconspicuous, low, parallel muri on each contact area; muri parallel interradial margin of amb, and coalesce about equatorial termini of laesurae.

DIMENSIONS: Equatorial diameter (19 specimens) 34 (43) 56 μ; polar diameter (3 specimens) 38 (41) 42 μ.

COMPARISON: The Australian specimens conform with Bolkhovitina's (1961, p. 53) diagnosis of the species, and are comparable also to the illustrated specimen which Markova (in Samoilovitch et al. 1961) assigned to *Anemia tripartita* Bolkhovitina. *Cicatricosisporites pseudotripartitus* (Bolkhovitina) is characterized by three series of four to five, weakly sinuous, closely-spaced, wide, rounded, distal muri which coalesce along amb-angle bisectors, and is distinct from *Anemia tripartina* which has more widely-spaced and narrower distal muri which project at equator (see Bolkhovitina loc. cit.; Pl. 15, fig. 2b). *C. pseudotripartitus* is distinguishable from other species of *Cicatricosisporites* recovered in the present study by its smaller size and wider distal muri which are more closely spaced.

DISTRIBUTION: The species has been reported previously from Cenomanian strata of U.S.S.R. only; from Yakutsk (Bolkhovitina 1961) and W. Siberia (Samoilovitch et al. 1961). In SE. Australia it occurs in the Tambo Formation (Albian) only in the Great Artesian Basin, and in certain horizons of the Upper Mesozoic sequence in the Otway Basin (see Tables 5, 6, 7, 9).

Cicatricosisporites hughesi sp. nov.

(Pl. X, fig. 6-16; Fig. 4r)

DIAGNOSIS: Microspores trilete, radially symmetrical, tetrahedral; amb convexly triangular. Laesurae straight, approximating equator, and enclosed within membraneous, elevated (2-3 μ high) lips. Exine one-layered, 2-3 μ thick; smooth over contact areas. Distal and equatorial regions sculptured with three series of six to seven, sinuous, sharply-crested (3-4 μ high) muri; muri of each series are arranged parallel both to each other and to interradial margins of amb, and terminate along amb-angle bisectors where they coalesce with alternate muri of neighbouring series. Muri 2-3 μ wide, narrower than intervening lumina (5-8 μ wide); width of four adjacent lumina and muri totals 30-35 μ.

DIMENSIONS: Equatorial diameter 36 (52) 64 μ; polar diameter (10 specimens) 31 (39) 56 μ.

HOLOTYPE: Preparation D294/1 21·1 110·7 P21965; Pl. X, fig. 6-8. Proximal aspect. Amb convexly triangular, 60 μ in diameter. Laesurae 28 μ long; lips 3 μ high. Sculpture of three series of seven, parallel, sinuous muri each 2 μ wide, 3 μ high, and spaced 5 μ apart; four muri and lumina total 30 μ in width.

LOCUS TYPICUS: South Australia, Penola Bore No. 1 at 1,805-15 ft.

REMARKS: Thin sections show the sculptural elements in transverse and oblique section. The sections depicted (Pl. X, fig. 15, 16) were obtained from a partially corroded specimen, and the one-layered exine shows slight differentiation along its inner margin.

COMPARISON: Conspecificity may exist between *Cicatricosisporites hughesi* sp. nov. and the spores assigned to *Appendicisporites tricornitatus* Weyland & Greifeld by Lantz (1958b; Pl. 3, fig. 25), Groot and Penny (1960; Pl. 1, fig. 4), and Groot et al. (1961; Pl. 24, fig. 6, 7); and those referred to both *Anemia caucasica* Bolkhovitina (1961; Pl. 17, fig. 4b, c) and *Ruffordia aralica* Bolkhovitina loc. cit.; Pl. 1, fig. 9f-h). A similar arrangement of sculptural elements is shown by *Anemia pseudomacrorhyza* Markova, *Appendicisporites punctutatus* Pacltova, and *Cicatricosisporites pseudotripartitus* (Bolkhovitina); *C. hughesi* differs, however, in its narrower, sinuous muri and greater width of four adjacent muri and lumina.

The spores of the modern species, *Anemia jaliscana* Maxon, differ in their larger size and wider muri (see Bolkhovitina 1961, p. 46; Pl. 11, fig. 6).

DISTRIBUTION: Widely distributed in certain horizons of the Upper Mesozoic of SE. Australia (see Tables 4-9). In the Great Artesian Basin it has been recovered from the Roma (Aptian), Tambo (Albian), and Winton (?Cenomanian) Formations. The similar specimens figured by Lantz (1958b), Groot and Penny (1960), Groot et al. (1961), and Bolkhovitina (1961) are from uppermost Wealden of England, Lower Cretaceous and Cenomanian of U.S.A., and Barremian-Albian of U.S.S.R.

Genus **Balmeisporites** Cookson & Dettmann 1958

TYPE SPECIES: *Balmeisporites holodictyus* Cookson & Dettmann 1958.

Balmeisporites holodictyus Cookson & Dettmann 1958

(Pl. XVII, fig. 7-10)

DIMENSIONS: Overall equatorial diameter 110 (145) 220 μ; polar diameter 125 (196) 266 μ.

REMARKS: Transverse sections (Pl. XVII, fig. 9, 10) confirm that the stratified exine forms the surface reticulum and the three, highly elevated, laesurate lips ('neck segments' of Cookson & Dettmann 1958a, p. 42); the lips are developed at the laesurate margins and not in the interlaesurate regions as shown in Cookson and Dettmann's Fig. 3.

DISTRIBUTION: A widely distributed species in E. Australia and Papua (Cookson and Dettmann 1958a, 1958b; present study, Tables 5-9). In the Great Artesian Basin its first occurrence is in uppermost horizons of the Roma Formation (Aptian), and it extends into the basal beds of the Winton Formation (?Cenomanian).

Balmeisporites tridictyus Cookson & Dettmann 1958

(Pl. XVII, fig. 11, 12)

DIMENSIONS: (4 specimens) Overall equatorial diameter 125 (140) 170 μ; polar diameter 170 (180) 196 μ.

DISTRIBUTION: Recovered from samples of the Tambo Formation (Albian) in the Great Artesian Basin, and from certain horizons in the Otway Basin (Cookson and Dettmann 1958a; present study, Tables 5-7, 9).

Balmeisporites glenelgensis Cookson & Dettmann 1958

DISTRIBUTION: This species which was described from Upper Cretaceous strata of the Otway Basin has since been recovered from the Winton Formation (?Cenomanian) of the Great Artesian Basin. Similar, if not identical, specimens have been reported recently from the Turonian of Siberia (Samoilovitch et al. 1961).

Genus **Pyrobolospora** Hughes 1955

TYPE SPECIES: *Pyrobolospora vectis* Hughes 1955.

REMARKS: The type species of this genus is characterized by six, highly elevated laesurate lips and exoexinal 'appendages' which arise from a 'coarse reticulum'

(Hughes 1955, p. 205). Certain other species (e.g., *Pyrobolospora hexapartita* (Dijkstra)) included within the genus do not possess a surface reticulum and conform with Apiculati rather than Murornati. However, no formal subdivision of the genus is proposed here.

Pyrobolospora hexapartita (Dijkstra) Hughes 1955

DISTRIBUTION: Dijkstra (1951) and Hughes (1955) described the species from the English Wealden; Hughes (1958) indicates a Barremian/Aptian occurrence in these sediments. In Australia the species is known from Upper Mesozoic horizons in the Great Artesian and Otway Basins and in E. Victoria (Cookson and Dettmann 1958a; Dettmann 1959; present study, Tables 5-7, 9).

Pyrobolospora reticulata Cookson & Dettmann 1958

(Pl. XVII, fig. 13-16)

DIMENSIONS: (6 specimens) Overall equatorial diameter 230 (272) 343 μ; polar diameter (including 'neck') 430 (530) 693 μ.

REMARKS: The exine stratification is seen clearly in transverse sections (Pl. XVII, fig. 14-16); the exoexine forms the six, elevated, laesurate lips ('neck segments' of Cookson and Dettmann 1958a, p. 41) which surround the laesurae.

DISTRIBUTION: The species shows wide lateral distribution in E. Australia, and is known from the Tambo Formation (Albian) in the Great Artesian Basin (Cookson and Dettmann 1958a, 1958b; Dettmann 1959; present study, Tables 4-9).

Pyrobolospora nuda Cookson & Dettmann 1958

DISTRIBUTION: A rare type known from one Aptian-Albian sample in the Great Artesian Basin (Cookson and Dettmann 1958a; present study, Table 9).

Subturma ZONOTRILETES Waltz 1935

This subturma incorporates acavate, simple or lipped, trilete spores in which the sclerine is equatorially thickened and/or extended; the equatorial thickenings and/or extensions may encroach on to the proximal and/or distal surfaces.

The four infraturma categories of Zonotriletes Waltz are delineated on the basis of the position and character of the equatorial thickenings and/or extensions as follows:

(a) Auriculati Schopf; trilete, acavate spores with thickenings (valvae or appendices) or extensions (auriculae) in the equatorial, radial regions.
(b) Tricrassati infraturma nov.; trilete, acavate spores with thickenings (interradial crassitudes) or extensions (corona etc.) in the equatorial, interradial regions.
(c) Cingulati Potonié & Klaus; trilete, acavate spores with comprehensive equatorial thickening (cingulum) or extension (zona).
(d) Patinati Butterworth & Williams; trilete, acavate spores with comprehensive distal and equatorial thickening (patina).

REMARKS: Zonotriletes as defined above incorporates the acavate forms which Potonié and Kremp (1954, and later) and Potonié (1956, and later) assigned to Zonales Bennie & Kidston sensu Potonié & Kremp (1954) and its subturma categories, Auritotriletes Potonié & Kremp and Zonotriletes Waltz sensu Potonié & Kremp (1954). The zonate, lipped forms (e.g. *Thomsonia* Mädler) of Barbates also conform with Zonotriletes.

The present assignment of Zonotriletes to Triletes is in accordance with Bennie and Kidston's (1886) original allocation of zonate forms to Triletes and not with the grouping proposed by Potonié and Kremp (1954).

Infraturma Auriculati Schopf emend.

The acavate, trilete spores, which may have simple or lipped laesurae, of this group are characterized by sclerinous thickenings (valvae or appendices) or extensions (auriculae) in the three radial regions at the equator. As such this infraturma incorporates the spores previously attributed to both Auriculati Schopf sensu Potonié & Kremp (1954) and Appendiciferi Potonié.

The following are examples of spores assignable to Auriculati Schopf:

(a) valvate spores; *Matonisporites* Couper, *Trilobosporites* Pant ex Potonié, *Triquitrites* Wilson & Coe.
(b) spores with appendices; *Appendicisporites* Weyland & Krieger, *Elaterites* Wilson.
(c) auriculate spores; *Tripartites* Schemel.

Genus **Matonisporites** Couper emend.

1958 *Matonisporites* Couper (pars), p. 139.
1961 *Boseisporites* Dev, p. 45-46.

Emended Diagnosis: Microspores trilete; amb triangular. Laesurae enclosed within membraneous, elevated lips. Exine differentially thickened; thickest in equatorial, radial regions where unsculptured valvae are developed. Exine smooth or almost smooth.

Type Species: *Matonisporites phlebopteroides* Couper 1958. Occurrence: Britain; Lias-Aptian.

Other Species:

(1) *Matonisporites cooksoni* sp. nov.
(2) *Matonisporites* (al. *Boseisporites*) *praeclarus* (Dev 1961, p. 46; Pl. 2, fig. 15) comb. nov. Occurrence: India; ?Aptian and later (after Arkell 1956, p. 384).
(3) *Matonisporites* (al. *Cyathidites*) *crassiangulatus* (Balme 1957, p. 22; Pl. 3, fig. 39-41) comb. nov. Occurrence: Western Australia; Oxfordian-Aptian.
(4) *Matonisporites* (al. *Phlebopteris*) *conspicuus* (Bolkhovitina 1953, p. 55; Pl. 8, fig. 19) comb. nov. Occurrence: U.S.S.R.; Aptian.
(5) *Matonisporites* (al. *Callispora*) sp. Dev 1961, p. 44; Pl. 1, fig. 4. Occurrence: India; ?Aptian and later (Arkell loc. cit.).

Trilites gigantis Cookson and *Lygodium cavernosum* Ivanova are not entirely conformable with *Matonisporites* Couper; *Dictyophyllidites* (al. *Matonisporites*) *equiexinus* (Couper) is excluded from the genus as emended herein.

Remarks and Comparison: The genus is here restricted to incorporate only smooth-walled, trilete microspores having exinal thickenings (valvae) in the three, radial regions at the equator, and is transferred to the Infraturma Auriculati (cf. Potonié 1960).

Matonisporites Couper and *Boseisporites* Dev are almost certainly comparable in morphology; the 'infragranulate' spores attributed to *B. praeclarus* Dev are probably corroded examples of a smooth-walled form. *Triquitrites* Wilson & Coe has a valvate exine, but this genus differs from *Matonisporites* in lacking elevated, laesurate lips. *Matonisporites* is distinct also from *Auritulina* Maljavikina ex Potonié which has unthickened radial extensions of the exine at the equator, and *Trilobozonosporites* Pant ex Potonié which is cingulate.

Affinity: Couper (1958) discussed the possible affinity of his species, *Matonisporites phlebopteroides*, with three Mesozoic species of *Phlebopteris* Brongn. (*P. muensteri* (Schenk.), *P. hirsuta* Sahni & Sitholey, and *P. indica* Sahni & Sitholey), and Bolkhovitina (1953) noted that *Matonisporites conspicuus* (Bolkhovitina) resembles the spores of *Phlebopteris muensteri. Matonisporites* is comparable also to the spores produced by certain living species of *Dicksonia* L'Herit, e.g., *D. sellowiana* (Pr.) (see Bolkhovitina 1956; Pl. 7, fig. 100 c, d) and *D. antarctica* Labill. (see Duigan and Cookson 1956; Pl. 1, fig. 1).

Matonisporites cooksoni sp. nov.

(Pl. XI, fig. 1-8)

DIAGNOSIS: Microspores trilete; biconvex, the distal surface strongly convex. Amb triangular with rounded angles and straight to concave sides. Laesurae sinuous, extending almost to equator; with membraneous, elevated (1-2 μ high) lips and weakly thickened margins. Exine one-layered, 2-3 μ thick; thicker (5-6 μ) in each equatorial, radial region. Proximal exine smooth except for small punctae which are linearly arranged (*c.* 2 μ apart) about the laesurate margins; distal exine smooth or with a faint OL pattern under oil immersion.

DIMENSIONS: Equatorial diameter 59 (65) 78 μ; polar diameter (4 specimens) 39 (43) 48 μ.

HOLOTYPE: Preparation D294/1 22·7 112·1 P21965; Pl. XI, fig. 1-2. Proximal aspect. Amb triangular 67 μ in diameter. Laesurae 31 μ long, sinuous; lips membraneous, 1-2 μ high. Exine 2·5 μ thick, thicker (6 μ) in valvate regions; proximal punctae linearly arranged about laesurate margins.

LOCUS TYPICUS: South Australia, Penola Bore No. 1 at 1,805-15 ft.

REMARKS AND COMPARISON: The proximal punctae may have resulted from corrosion, but they are developed on all seemingly well-preserved specimens. Some specimens (Pl. XI, fig. 5) show a striking resemblance to the holotype of *Matonisporites conspicuus* (Bolkhovitina), the description of which, however, does not mention sinuous laesurae or proximal punctae. *M. cooksoni* sp. nov. differs from *M. phlebopteroides* Couper and *M. crassiangulatus* (Balme) in having sinuous laesurae and pitted laesurate margins. *M. praeclarus* (Dev) is larger and has a thicker exine.

DISTRIBUTION: The species shows wide lateral distribution in the Upper Mesozoic of SE. Australia (see Tables 3-9); it has not been observed in samples of the Winton Formation in the Great Artesian Basin.

Genus **Trilobosporites** Pant ex Potonié 1956

1954 *Trilobosporites* Pant (nom. nud.), p. 54.
1956 *Trilobosporites* Pant ex Potonié p. 55.
1961 *Lygodium* Swartz: Ivanova (pars) in Samoilovitch et al., p. 90.

TYPE SPECIES: *Trilobosporites hannonicus* (Delcourt & Sprumont) Potonié 1956.

REMARKS AND COMPARISON: Potonié (1956, p. 55) validated the genus and selected the type species which has a valvate, verrucate exine (see Delcourt et al. 1963). The presence of these features distinguishes the genus from the azonate, verrucate forms of *Concavissimisporites* Delcourt & Sprumont and the valvate, laevigate spores of *Matonisporites* Couper.

Potonié (1956), Couper (1958), Pocock (1962), and others have attributed several Mesozoic species to *Trilobosporites*, while some Russian authors have assigned comparable Mesozoic spores to *Lygodium* Swartz. Such an assignment implicitly suggests that the fossil spores have an affinity with *Lygodium*, but little supporting evidence has been brought forward for this relationship.

Trilobosporites trioreticulosus Cookson & Dettmann 1958

(Pl. XII, fig. 1-9)

1958 *Trilobosporites trioreticulosus* Cookson & Dettman, p. 109; Pl. 17, fig. 1-3.
1961 *Lygodium trioreticulosus* (Cookson & Dettman) Bolkhovitina (pars), p. 100; Pl. 35, fig. 5b; Pl. 38, fig. 8.
1961 *Lygodium trioreticulosum* (Cookson & Dettmann) Ivanova (excl. var.) in Samoilovitch et al., p. 111.

DESCRIPTION: Microspores trilete; amb triangular with straight or concave sides and truncated angles; polar outline elliptical. Laesurae straight, length $\frac{3}{4}$ spore radius, and with narrow (3-4 μ wide), low lips which are composed of coalescent verrucae. Exine valvate; consists of one, sculptured, homogeneous layer which is 3-5 μ thick in valvate regions and thinner (2·5-4 μ) elsewhere. Valvae reticulate; each reticulum comprises weakly sinuous, anastomosing muri (3-5 μ wide, 2-3 μ high) and fourteen to twenty, polygonal to subcircular lumina 7-9 μ in diameter. Remainder of exine with closely-spaced, low, irregular granules and verrucae (1-2 μ in maximum basal diameter).

DIMENSIONS: Equatorial diameter 59 (69) 81 μ; polar diameter (4 specimens) 42 (50) 56 μ.

REMARKS: Transverse sections (Pl. XII, fig. 8, 9) show that the one-layered exine is thicker (valvate) and more heavily sculptured in each equatorial, radial region.

COMPARISON: *Cibotium reticuliangulatum* Maljavikina (1958, p. 53; Pl. 5, fig. 13) and the illustrated specimen assigned by Groot and Penny (1960; Pl. 2, fig. 2) to *Trilobosporites apiverrucatus* Couper may be comparable to *T. trioreticulosus* Cookson & Dettmann. The species is distinct from *T. apiverrucatus* and *T. hannonicus* (Delcourt & Sprumont), both of which have discrete verrucae in their valvate regions. *Cibotiumidites giganteus* Maljavikina is described as cingulate (see Potonié 1960, p. 63).

DISTRIBUTION: Widely distributed in E. Australia (see Cookson and Dettmann 1958b; present study, Tables 5-7, 9), and apparently restricted to the Tambo (Albian) and uppermost horizons of the Roma (Aptian) Formations in the Great Artesian Basin. Bolkovitina (1961) and Samoilovitch et al. (1961) record the species in Barremian-Cenomanian strata of U.S.S.R., but this stratigraphical range also includes that of *Trilobosporites purverulentus* (Verbitskaya) (= *Lygodium trioreticulosum* var. *senomanicum* Ivanova).

Trilobosporites purverulentus (Verbitskaya) comb. nov.

(Pl. XIII, fig. 1-5)

1958 *Lygodium* sp.: Verbitskaya; Pl. 3, fig. 43.
1961 *Lygodium trioreticulosus* (Cookson & Dettmann) Bolkhovitina (pars), p. 100; Pl. 35, fig. 5a, c, d.
1961 *Lygodium trioreticulosum* (Cookson & Dettmann) var. *senomanicum* Ivanova in Samoilovitch et al., p. 111; Pl. 31, fig. 2a, b.
1962 *Lygodium purverulentus* Verbitskaya, p. 101; Pl. 9, fig. 48a-c.

DESCRIPTION: Microspores trilete, biconvex; amb triangular with straight or concave sides and broadly rounded angles. Laesurae straight, length $\frac{2}{3}$-$\frac{3}{4}$ spore radius, and with weakly thickened margins. Exine 2-3·5 μ thick; slightly thicker (3·5-5 μ) in three, equatorial, radial regions (valvate). Valvae reticulate; reticula consist of broadly rounded, sinuous muri (2·5-4 μ wide) and irregularly elongated to subcircular lumina which are 1·5-3 μ in maximum diameter and which number twenty-five to thirty per reticulum. Remainder of exine granulate to subverrucate.

DIMENSIONS: Equatorial diameter (14 specimens) 59 (72) 88 μ; polar diameter (2 specimens) 42 μ, 48 μ.

COMPARISON: The species is clearly distinct from *Trilobosporites trioreticulosus* Cookson & Dettmann in having smaller and more lumina on its valvae together with a more finely sculptured polar exine.

DISTRIBUTION: Recorded previously from U.S.S.R. in Albian-?Cenomanian strata (Verbitskaya 1962); the Barremian-Cenomanian age range quoted by Bolkhovitina (1961) and Samoilovitch et al. (1961) includes the ranges of both *T. trioreticulosus* and *T. purverulentus* (Verbitskaya). In the present study the species was recovered from samples of the Blythesdale Group and the Roma (Aptian) and Tambo (Albian) Formations in the Great Artesian Basin (see Tables 4-6).

Trilobosporites tribotrys sp. nov.

(Pl. XII, fig. 10-14)

1961 *Lygodium* sp.: Samoilovitch et al.; Pl. XXXIV, fig. 5-7.

DIAGNOSIS: Microspores trilete; amb triangular with straight or concave sides and rounded angles; polar outline elliptical. Laesurae straight, length ¾ spore radius, and with conspicuous, verrucate lips 5-7 μ wide. Exine 2-3 μ thick, thicker in equatorial, radial regions (valvate). Valvae with low, narrow (2-3 μ wide), anastomosing muri which enclose polygonal lumina (4-5 μ in diameter) and from which arise conspicuous, hemispherical to spherical (4-5 μ high, 4-5 μ in basal diameter) verrucae. Remainder of exine with low, closely-spaced, irregular granules and verrucae (1-3 μ in basal diameter, 1-2 μ high).

DIMENSIONS: (10 specimens) Equatorial diameter 67 (77) 91 μ.

HOLOTYPE: Preparation D217/22 34·5 118·9 P22061; Pl. XII, fig. 10, 11. Proximal aspect. Amb triangular with straight sides, 67 μ in diameter. Laesurae 36 μ long; lips 5 μ wide. Exine 2·5 μ thick; valvae with verrucae (4 μ high, 4-5 μ in basal diameter) and narrow (2 μ wide) muri. Exine otherwise subverrucate; verrucae 1-2 μ in basal diameter.

LOCUS TYPICUS: South Australia, Robe Bore No. 1 at 1,400 ft.

COMPARISON: The large, hemispherical to spherical verrucae which are developed on the valvae distinguish the species from *Trilobosporites trioreticulosus* Cookson & Dettmann and *T. purverulentus* (Verbitskaya). *T. apiverrucatus* Couper and *Lygodium multituberculatum* Bolkhovitina resemble *T. tribotrys* sp. nov., but are distinct in having larger verrucae in the polar regions and in the absence of anastomosing muri on the valvae. *Lygodium bellum* Ivanova is smaller and has discrete verrucae on its valvae.

DISTRIBUTION: A rare type recovered from a few samples of the Great Artesian and Otway Basins (see Tables 5-7). Comparable spores depicted by Samoilovitch et al. (1961) are from Cenomanian strata of W. Siberia.

Genus **Trilites** Erdtman ex Couper emend.

1947 *Trilites* Erdtman (nom. nud.), p. 110.
1947 *Trilites* Erdtman (nom. nud.): Cookson, p. 136.
1951 *Lygodioisporites* Potonié (nom. nud.), p. 144.
1953 *Trilites* Cookson ex Couper, p. 29.
1955 *Lygodioisporites* Potonié ex Delcourt & Sprumont, p. 33.
1956 *Trilites* (Erdtman, Cookson) ex Couper: Potonié, p. 26.

EMENDED DIAGNOSIS: Microspores trilete; amb triangular. Exine differentially thickened in equatorial, radial regions where sculptured valvae are developed. Sculptural elements include distal and equatorial, sometimes anastomosing, elongated verrucae or rugulae which are larger on valvae. Proximal contact areas smooth to scabrate.

TYPE SPECIES: *Trilites tuberculiformis* Cookson 1947, p. 136; Pl. 16, fig. 61, 62 emend. Occurrence: Kerguelen, Lower Tertiary.

The following description of the species is based upon the holotype together with more than 30 examples which have been recovered by the present writer from a sample labelled Cumberland Bay, Kerguelen and lodged in the British Museum of Natural History (No. 75·139(102); see Cookson 1947, p. 143). The type and three other specimens are depicted in Pl. XXVII, fig. 4-8.

EMENDED DIAGNOSIS: Microspores trilete, biconvex to plano-convex, the distal strongly convex. Amb triangular with weakly concave to convex sides. Laesurae straight, approximating equator. Exine 2-3 μ thick, thicker (3-4 μ) in equatorial, radial regions; faintly scabrate on contact areas and rugulate to verrucate elsewhere. Sinuous, closely-spaced, sometimes anastomosing, randomly orientated sculptural elevations 3 μ high, 2-3 μ wide, and 3-10 μ long. Elements larger (3-4 μ wide, 4-5 μ high) on valvae.

DIMENSIONS: Equatorial diameter 42 (51) 59 μ; polar diameter (7 specimens) 31 (37) 39 μ.

HOLOTYPE: P22726. Cookson 1947; Pl. 16, fig. 61: present study; Pl. XXVII, fig. 4, 5. Distal aspect. Amb concavely triangular, 52 μ in diameter. Laesurae 21 μ long. Exine 2 μ thick, thicker (4 μ) in equatorial, radial regions; contact areas smooth, remainder of exine with sculptural elevations 3 μ high, 3 μ wide, and up to 10 μ long.

LOCUS TYPICUS: Kerguelen, Waterfall Gorge (sample 81a).

REMARKS: The majority of the specimens which have been examined are compressed, and some are corroded. The Triassic spores which Klaus (1960) assigned to the species appear to be distinct from the Kerguelen specimens in the absence of valvae and in having shorter laesurae.

OTHER SPECIES OF TRILITES: The Tertiary species, *T. solidus* (Potonié), *T. asolidus* Krutzsch, and *T. parvallatus* Krutzsch are comparable to *Trilites* as emended herein. The majority of the species attributed to the genus by Cookson and subsequent authors are clearly distinct from *Trilites.*

DISCUSSION: The name *Trilites* was first used by Cookson (1947) for several diversely sculptured, trilete forms which she described from Lower Tertiary deposits of Kerguelen. Couper (1953) subsequently allocated generic rank to *Trilites* and designated the type species *T. tuberculiformis* Cookson. Couper's generic diagnosis, however, embraces spores attributable to many well established, pre-existing genera. Potonié (1956) and Klaus (1960) suggested, but did not formally propose, that *Trilites* should be restricted to incorporate trilete microspores having a triangular amb and a uniformly thick, verrucate exine. Meanwhile, Krutzsch (1959) used the genus for 'corrugate-rugulate', trilete microspores, some of which have a differentially thickened exine.

Upon an examination of the type and other specimens attributable to *Trilites tuberculiformis*, the present writer has concluded that the species is characterized by verrucate to rugulate sculpture distally together with a valvate exine. As such, *Trilites* is comparable morphologically to the type species of Potonié's (1951) genus *Lygodioisporites*. Of the two genera *Trilites* has the priority since it was validated prior to the validation by Delcourt and Sprumont (1955) of *Lygodioisporites*.

COMPARISON: The genus is similar to *Trilobosporites* Pant ex Potonié, but is readily distinguishable in having anastomosing, elongated elevations distally together with a smooth exine about the laesurae. *Matonisporites* Couper is distinct in having a smooth exine, while the type species of *Corrugatisporites* Thomson & Pflug ex Weyland & Greifeld is sculptured with three series of more or less parallel muri.

AFFINITY: The spores of *Dicksonia squarrosa* (Forst.) appear to be comparable to *Trilites* (see Harris, W. F. 1955; Couper 1960).

Trilites cf. T. tuberculiformis Cookson 1947

(Pl. XI, fig. 16-19)

DESCRIPTION: Microspores trilete, biconvex; amb triangular with weakly convex to straight sides. Laesurae straight, approximating the equator, and with membraneous, elevated lips *c.* 1 μ high. Exine 2 μ thick, thicker (3-4 μ) in equatorial, radial regions; smooth proximally and verrucate to rugulate both distally and equatorially. Sinuous, sometimes anastomosing, closely-spaced elements broadly rounded in optical section. Elements 3 μ high, 3 μ wide, and up to 10 μ long distally; valvae with larger (3-4 μ high, 4-5 μ wide) elements.

DIMENSIONS: Equatorial diameter (15 specimens) 31 (42) 50 μ; polar diameter (2 specimens) 26 μ, 42 μ.

COMPARISON: The SE. Australian specimens are similar to *Trilites tuberculiformis* Cookson, but are smaller in size and have elevated lips. The species is distinct from *T. solidus* (Potonié), *T. asolidus* Krutzsch, and *T. paravallatus* Krutzsch in having larger (higher and wider) sculptural elevations. The spores of *Rugutriletes toratus* Pierce appear to be more coarsely sculptured.

DISTRIBUTION: This form is of infrequent occurrence in the upper horizons of the Blythesdale Group and in the Roma, Tambo, and Winton Formations of the Great Artesian Basin; a few specimens have been recovered from the Murray and Otway Basins (see Tables 4-6, 8, 9).

Genus **Ischyosporites** Balme 1957

TYPE SPECIES: *Ischyosporites crateris* Balme 1957.

Balme (1957, p. 23) instituted the genus, the diagnosis and type species of which incorporate trilete microspores having anastomosing muri distally and exinal thickenings (valvae) in the equatorial, radial regions. Since the presence of valvae is considered to be a diagnostic criterion of the Infraturma Auriculati, *Ischyosporites* Balme is here transferred to this infraturma (cf. Potonié 1960, p. 46).

COMPARISON: *Trilites* Erdtman ex Couper is distinct in having verruco-rugulate sculpture of irregular, freely terminating muri and intercommunicating lumina. *Trilobosporites* Pant ex Potonié is characterized by granulate to verrucate sculpture in the polar regions of its exine, and *Klukisporites* Couper does not possess a valvate exine.

Ischyosporites punctatus Cookson & Dettmann 1958

(Pl. XI, fig. 9-15)

DESCRIPTION: Microspores trilete, biconvex; amb triangular with rounded angles and straight or weakly concave sides. Laesurae straight, extending almost to amb, and with slightly thickened, pitted margins; pits (which are probably due to corrosion) small (*c.* 1 μ), closely spaced. Exine 3-5 μ thick, thicker (4-7 μ) in equatorial, radial regions (valvate); composed of one, homogeneous layer which has distal and equatorial foveo-reticulate sculpture. Lumina circular to elliptical in outline, 4-10 μ in diameter, up to 3 μ deep, and separated by rounded muri 4-6 μ wide; lumina larger, deeper, and more closely spaced on valvae.

DIMENSIONS: Equatorial diameter 42 (56) 57 μ; polar diameter (3 specimens) 42 (44) 48 μ.

COMPARISON: The species is similar to *Ischyosporites crateris* Balme which, however, has larger lumina especially about the distal pole. Small, corroded specimens of *Trilobosporites trioreticulosus* Cookson & Dettmann and *T. purverulentus* (Verbitskaya) occasionally simulate *Ischyosporites punctatus* Cookson & Dettmann, but they are distinguishable in having smaller lumina which are entirely absent about the distal pole.

DISTRIBUTION: Widely distributed in SE. Australia, being more frequent in the lower horizons of the Upper Mesozoic sequence in the Great Artesian Basin (see Cookson and Dettmann 1958b; Dettmann 1959; present study, Tables 3-9). It is known also from Upper Jurassic and Aptian deposits of Western Australia (Cookson and Dettmann 1958b).

Infraturma TRICRASSATI infraturma nov.

Tricrassati is here proposed for trilete, acavate spores having simple or lipped laesurae and sclerine thickenings (interradial crassitudes) or extensions (corona) in the three interradial regions at the equator. In polar view, the thickenings or extensions are widest interradially and taper towards the equatorial radial regions where they are lacking.

REMARKS AND COMPARISON: Tricrassati is distinct from Cingulati in having equatorial thickenings or extensions which are confined to the interradial regions. Tricrassati is also distinguishable from Auriculati, which has radially situated, equatorial thickenings, and Patinati which is thickened over the entire distal hemisphere.

Spores attributable to this group include:

(a) spores with interradial crassitudes; *Rotaspora* Schemel, *Camarozonosporites* Pant ex Potonié, *Sestrosporites* gen. nov.

(b) spores with equatorial, interradial extensions (corona etc.); *Zebrasporites* Klaus, *Reinschospora* Schopf, Wilson, & Bentall, *Diatomozonotriletes* Naumova ex Playford.

Genus **Gleicheniidites** Ross ex Delcourt & Sprumont emend.

1949 *Gleicheniidites* Ross (nom. nud.), p. 31.
1955 *Gleicheniidites* Ross ex Delcourt & Sprumont, p. 26.
1957 *Triremisporites* Delcourt & Sprumont, p. 61.
1959 *Gleicheniidites* Ross ex Delcourt & Sprumont emend. Delcourt & Sprumont p. 34.
1959 *Gleicheniidites* Ross emend. Krutzsch (pars) p. 109.
1961 *Gleichenia* J. E. Smith: Grigorjeva (pars) in Samoilovitch et al., p. 44.
1961 non *Gleicheniidites* Grigorjeva in Samoilovitch et al., p. 59 non Ross ex Delcourt & Sprumont 1955.

EMENDED DIAGNOSIS: Microspores trilete; amb triangular. Exine smooth or almost smooth, and with exinal thickenings (crassitudes) in each equatorial, interradial region.

TYPE SPECIES: *Gleicheniidites senonicus* Ross 1949.

REMARKS AND COMPARISON: Delcourt and Sprumont (1955) formally allocated generic rank to *Gleicheniidites* Ross, and selected the type species, *G. senonicus* Ross. The illustrated holotype of this species has a smooth, trilete exine which is thickened in the interradial regions at the equator. Similar spores were assigned by Delcourt & Sprumont (1957) to the type species of their genus, *Triremisporites,* and these authors subsequently (1959) recognized that the two genera (*Gleicheniidites* and *Triremisporites*) are synonymous. Krutzsch (1959) redefined *Gleicheniidites* to receive both smooth and spinose, trilete microspores having a thickened exine in the equatorial, interradial regions. Five of the six subgeneric categories proposed by Krutzsch incorporate smooth-walled spores and conform with the above generic diagnosis; Krutzsch's other subgeneric category, *Peregrinisporis,* contains microspores having spinose sculpture, and these spores are excluded from *Gleicheniidites* as emended above.

Attention is drawn to Grigorjeva's (in Samoilovitch et al. 1961) recent assignment of *G. senonicus* to the living genus *Gleichenia* J. E. Smith, and to her proposal (loc. cit. p. 59) to conserve *Gleicheniidites* for dispersed spores morphologically distinct from those of *Gleicheniidites* Ross ex Delcourt & Sprumont. *Gleicheniidites* Grigorjeva is thus a later homonym of *Gleicheniidites* Ross ex Delcourt & Sprumont (International Code of Botanical Nomenclature 1961, Art. 48), and *Gleicheniidites* Grigorjeva cannot be conserved against *Gleicheniidites* Ross ex Delcourt & Sprumont unless Grigorjeva's proposal is approved by the General Committee on Botanical Nomenclature (loc. cit. Art. 14, 15).

The type species of *Fasciatisporites* Sato may be comparable to *Gleicheniidites* Ross ex Delcourt & Sprumont, but Sato's (1961) illustrations do not convincingly show that the species is characterized by interradial crassitudes at the equator.

AFFINITY: The spores of modern *Gleichenia circinata* Swartz (see Cookson 1953; Pl. 1, fig. 7) and of *G. laevissima* Christ. (see Erdtman 1957; Fig. 114C) are comparable morphologically to *Gleicheniidites.*

Gleicheniidites cf. **G. cercinidites** (Cookson) comb. nov.

(Pl. XIII, fig. 6-10)

SELECTED SYNONYMY:

1953 *Gleichenia cercinidites* Cookson, p. 464; Pl. 1, fig. 5-6.
1957 *Gleichenia* cf. *G. cercinidites* Cookson: Balme, p. 23; Pl. 3, fig. 42-44.

DESCRIPTION: Microspores trilete; biconvex, the distal surface strongly arched or with three, arcuate, interradial folds about the pole. Amb triangular with concave or straight sides and acutely rounded angles. Laesurae straight to weakly sinuous, extending to amb, and with narrow, elevated (1-2 μ high) lips. Exine smooth, 1-1·5 μ thick; thicker at equator where three, interradial crassitudes (3-6 μ in maximum width) are developed.

DIMENSIONS: Equatorial diameter 23 (32) 42 μ.

AFFINITY: Cookson (1953) demonstrated that her species *Gleicheniidites cercinidites* is comparable to the spores, which have equatorial, interradial crassitudes, of *Gleichenia cercinata* Swartz.

DISTRIBUTION: The species was described from Lower Tertiary deposits of South Australia and Victoria (Cookson 1953). The similar form, *Gleicheniidites* cf. *G. cercinidites,* is of common occurrence both in the Upper Jurassic and Lower Cretaceous of Western Australia (Balme 1957) and in Upper Mesozoic sediments of SE. Australia (see Tables 3-9).

Genus **Sestrosporites** gen. nov.

DIAGNOSIS: Microspores trilete; laesurae simple or lipped. Exine differentially thickened in equatorial, interradial regions where crassitudes are developed. Sculpture foveolate to foveo-reticulate.

TYPE SPECIES: *Sestrosporites* (al. *Foveotriletes*) *irregulatus* (Couper 1958, p. 143; Pl. 22, fig. 9, 10) comb. nov. Occurrence: Britain; Oxfordian-Kimeridgian.

HOLOTYPE: Couper 1958, p. 143; Pl. 22, fig. 9: present study; Pl. XXVII, fig. 1-3. Oblique proximal aspect. Amb triangular with weakly convex sides; 48 μ in diameter. Laesurae straight, extending to equator, and with elevated (1-2 μ high) lips. Exine 2 μ thick but thicker (3-4 μ) in equatorial, interradial regions where narrow crassitudes are developed. Proximal surface smooth; distal surface sculptured with deep foveolae which are circular to irregularly elongated in outline (1-3 μ in maximum diameter) and spaced 1-3 μ apart.

OTHER SPECIES:

Sestrosporites (al. *Cingulatisporites*) *pseudoalveolatus* (Couper 1958, p. 147; Pl. 25, fig. 5, 6) comb. nov.

COMPARISON: The foveolate sculptured features distinguish the genus from *Gleicheniidites* Ross ex Delcourt & Sprumont, *Camarozonosporites* Pant ex Potonié, *Camarozonotriletes* Naumova ex Naumova, and *Rotaspora* Schemel. *Foveosporites* Balme lacks equatorial crassitudes.

AFFINITY: The spores of *Lycopodium manii* (Hillebr.), which are described by Selling (1946, p. 16; Pl. 1, fig. 13-15), and those of *L. laterale* R. Br. (see Harris, W. F. 1955) are comparable to *Sestrosporites* gen. nov.

Sestrosporites pseudoalveolatus (Couper) comb. nov.

(Pl. XIII, fig. 11-16)

1958 *Cingulatisporites pseudoalveolatus* Couper, p. 147; Pl. 25, fig. 5, 6.

DESCRIPTION: Microspores trilete, with a convexly triangular amb; distal surface convex, proximal surface pyramidal. Laesurae straight, extending to equator, and enclosed within membraneous, elevated (2 μ high) lips. Proximal and distal exine 2 μ thick; equatorial exine differentially thickened in interradial regions where crassitudes are developed. Crassitudes cavate, 4-6 μ wide interradially, narrowing to 2 μ in radial regions. Compressed specimens usually with a membraneous equatorial 'zona' (3-5 μ wide) which is formed from the outermost portion of the cavate crassitudes. Exine comprehensively sculptured with deep foveolae that are circular in outline, 0·5-1 μ in diameter, and spaced 2-3 μ apart.

DIMENSIONS: Equatorial diameter (14 specimens) 39 (48) 64 μ.

REMARKS: The specimen (Pl. XIII, fig. 14) which shows a membraneous 'zona' is comparable in all respects to *Sestrosporites pseudoalveolatus* (Couper), and the 'azonate' specimens (Pl. XIII, fig. 11-13) are considered to be well-preserved representatives of the same species. It was found that by subjecting spores of the latter type to prolonged maceration and/or compression, the outermost portion of their cavate, interradial crassitudes ruptured and formed a membraneous 'zona' comparable to that seen in the holotype. It is perhaps noteworthy to add that Couper (1958, p. 147) recorded some specimens with 'only traces of the cingulum', and, moreover, that the two specimens figured by Couper (and which have been examined by the present writer) were subjected to prolonged (6 days') treatment with concentrated nitric acid and potassium chlorate.

Thin sections (Pl. XIII, fig. 15, 16) confirm that the interradial crassitudes are cavate.

COMPARISON: *Sestrosporites irregulatus* (Couper) has narrower interradial crassitudes together with more closely-spaced and irregularly shaped foveolae.

DISTRIBUTION: Couper (1958) described the species from Bajocian-Aptian of Britain. In SE. Australia it is of rare occurrence throughout the Upper Mesozoic sequence in the Great Artesian Basin; it has been recovered also from some horizons of the Otway Basin (see Tables 3-8).

Genus **Coronatispora** gen. nov.

DIAGNOSIS: Microspores trilete; laesurae simple or lipped. Exine differentially thickened in equatorial, interradial regions where crassitudes are developed. Distal hemisphere with a circumpolar ridge which concentrically encircles a polar thickening; polar, circumpolar, and equatorial thickenings may be connected by radially arranged elevations. Sculpture foveolate to reticulate.

TYPE SPECIES: *Coronatispora perforata* sp. nov.

OTHER SPECIES:

(1) *Coronatispora* (al. *Microreticulatisporites*) *telata* (Balme 1957, p. 25; Pl. 4, fig. 52, 53) comb. nov.

(2) *Coronatispora* (al. *Cingulatisporites*) *valdensis* (Couper 1958 p. 146; Pl. 24 fig. 6, 7) comb. nov. Occurrence: England; Wealden-Aptian. The specimen figured by Lantz (1958b; Pl. 3, fig. 28) of *Cingulatisporites* cf. *caminus* Balme, and those of *Staplinisporites caminus* (Balme) Pocock (1962; Pl. 5, fig. 87; Pl. 6, fig. 88-90) appear to be conformable with *Coronatispora valdensis.*

COMPARISON: In possessing equatorial thickenings (interradial crassitudes), the genus is distinct from *Staplinisporites* Pocock, *Neochomotriletes* Reinhardt, and *Taurocusporites* Stover all of which show a similar concentric arrangement of distal thickenings (or elevations). These distal features distinguish *Coronatispora* gen. nov. from *Camarozonosporites* Pant ex Potonié, *Rotaspora* Schemel, *Camarozonotriletes* Naumova ex Naumova, *Zebrasporites* Klaus, and *Sestrosporites* gen. nov.

Coronatispora perforata sp. nov.

(Pl. XIII, fig. 17-25)

DIAGNOSIS: Microspores trilete; amb convexly triangular to subcircular; distal surface convex, proximal surface pyramidal. Laesurae straight, extending to equator; with thin (*c.* 1 μ thick), elevated (3 μ high), undulose lips. Exine 1·5-2 μ thick; thicker distally and in each equatorial, interradial region. Equatorial thickenings (interradial crassitudes) cavate; attaining maximum width (4-8 μ) interradially, and narrowing to 2 μ at radii. Distal thickenings include a scabrate, polar crassitude which is circular in outline and 7-10 μ in diameter; and a narrow (2 μ wide), low, scabrate, circumpolar ridge which is situated midway between (and 5-8 μ from) the polar and equatorial crassitudes. Exine, except for distal thickened areas, with circular to elliptical foveolae 1-2 μ in diameter and spaced 2-3 μ apart.

DIMENSIONS: Equatorial diameter (27 specimens) 26 (46) 53 μ.

HOLOTYPE: Preparation D304/2 18·5 109·7 P22070; Pl. XIII, fig. 17-19. Proximal aspect. Amb convexly triangular, 44 μ in diameter. Laesurae 22 μ long. Exine 1·5 μ thick; equatorial interradial crassitudes cavate, 6 μ in maximum width. Distal polar thickening circular in outline, 7 μ in diameter; circumpolar ridge 2 μ wide. Foveolae circular to elliptical, 1-2 μ in diameter.

LOCUS TYPICUS: South Australia, Cootabarlow Bore No. 2 at 1,471-72 ft.

DISCUSSION: Optical sections of spores in full polar view (Pl. XIII, fig. 18, 20) show the cavate nature of the equatorial crassitudes. Some 'zonate' specimens have been recovered; the 'zona' consists of the ruptured and unfurled, outermost portion of the cavate, interradial crassitudes. The illustrated 'zonate' specimen (Pl. XIII, fig. 21-23) has been compressed (by means of pressing the coverslip with a needle), and was, before compression, a typical representative of *Coronatispora perforata* sp. nov. (cf. discussion of *Sestrosporites pseudoalveolatus* (Couper)).

COMPARISON: The species differs from *Coronatispora telata* (Balme) and *C. valdensis* (Couper) in its foveolate sculpture; and from *Sestrosporites pseudoalveolatus* (Couper) in its distal polar thickening and circumpolar ridge.

DISTRIBUTION: Recovered from the lower intervals only of bores in the Great Artesian and Otway Basins (see Tables 3, 4, 6-8).

Coronatispora telata (Balme) comb. nov.

(Pl. XIV, fig. 1-4)

1957 *Microreticulatisporites telatus* Balme, p. 25; Pl. 4, fig. 52, 53.

DESCRIPTION: Microspores trilete, biconvex; amb convexly triangular to subcircular. Laesurae straight, extending to equator, and with thin (1-2 μ thick), elevated (1-2 μ high) lips. Exine differentially thickened, particularly at the equator where cavate crassitudes (3-6 μ in maximum width) are developed interradially. Distal exine thickened in a circular area (7-10 μ in diameter) about the pole, and with a low, wide (3-4 μ), circumpolar ridge situated approximately midway between pole and equator. Radially disposed, low, narrow (*c.* 2 μ wide) ridges anastomose with the polar, circumpolar, and equatorial thickenings to form a shallow distal reticulum with lumina 3-6 μ in diameter. Proximal exine 1-2 μ thick, smooth or with a few widely-spaced foveolae.

DIMENSIONS: Equatorial diameter (6 specimens) 39 (47) 53 μ.

REMARKS AND COMPARISON: The holotype of the species has cavate interradial crassitudes (see Balme 1957, Pl. 4, fig. 52). *Coronatispora telata* (Balme) is distinct from *C. valdensis* (Couper) in having a thicker exine, wider circumpolar ridge, and greater development of thickening at the equator.

DISTRIBUTION: The species is known from Australian sediments only: in Oxfordian-Aptian strata of Western Australia (Balme 1957), and in a few samples from South Australia (Great Artesian and Otway Basins) and E. Victoria (present study, Tables 4-8).

Infraturma CINGUALATI Potonié & Klaus emend.

Trilete, avacate spores attributable to this group have simple or lipped laesurae and are characterized by comprehensive equatorial thickening (cingulum), extension (zona), or thickened extension (cingulizona).

Cingulati Potonié & Klaus as circumscribed here includes not only cingulate and zonate forms but also cingulizonate forms (spores having a thickened equatorial extension which is membraneous near its outer margin and thicker at its inner limit). Segregation of these three morphological types into more restricted units (Cingulati Potonié & Klaus sensu Potonié and Kremp 1954 and Zonati Potonié & Kremp) seems undesirable since cingulizonate forms cannot adequately be distinguished from either cingulate or zonate types. Transverse sections of certain cingulizonate and cingulate spores (see Hughes et al. 1962, Dettmann and Playford

1963) indicate that there are no essential morphological differences between cingulizona and cingulum, except that the former tapers more sharply towards the equator.

Examples of spores assignable to Cingulati as defined above include:

(a) cingulate forms; *Murospora* Somers, *Cingutriletes* Pierce
(b) cingulizonate forms; *Cirratriradites elegans* (Waltz), *Densosporites intermedius* Butterworth & Williams
(c) zonate forms; *Kraeuselisporites* Leschik, *Cirratriradites saturni* (Ibrahim).

Genus **Cingutriletes** Pierce emend.

1961 *Cingutriletes* Pierce (pars), p. 20.

EMENDED DIAGNOSIS: Microspores trilete, cinuglate; amb subcircular to circular. Exine smooth or almost smooth.

TYPE SPECIES: *Cingutriletes congruens* Pierce 1961.

REMARKS AND COMPARISON: Pierce (1961) instituted the genus to incorporate cingulate, as well as interradially crassate, smooth-walled, trilete microspores. The interradially crassate forms, which have a concavely triangular amb, are excluded from *Cingutriletes* Pierce as emended above, and conform with *Gleicheniidites* Ross ex Delcourt & Sprumont.

Cingutriletes is similar to *Anulatisporites* Loose ex Potonié & Kremp but, pending reappraisal of the latter genus by the International Commission for the Microflora of the Palaeozoic (I.C.M.P.), *Cingutriletes* is retained for Mesozoic and Tertiary forms that conform with the above diagnosis. The genus may be comparable to *Discisporites* Leschik, the morphology of which, however, is imprecisely known. *Murospora* Somers is distinct in having a concavely triangular amb.

Cingutriletes clavus (Balme) comb. nov.

(Pl. XIV, fig. 5-8)

SELECTED SYNONYMY:

1953 *Sphagnites australis* (Cookson) f. *crassa* Cookson, p. 464; Pl. 1, fig. 2-4.
1953 cf. *Sphagnites australis* (Cookson) f. *crassa* Cookson, p. 469; Pl. 2, fig. 24.
1956 *Sphagnumsporites australis* (Cookson) f. *crassa* Cookson: Potonié, p. 17.
1957 *Sphagnites clavus* Balme, p. 16; Pl. 1, fig. 4-6.
1959 *Stereisporites crassus* (Cookson) Krutzsch, p. 73.
1959 *Sphagnumsporites clavus* (Balme) de Jersey, p. 348; Pl. 1, fig. 2.
1961 *Sphagnum australe* (Cookson) Drozhastchich f. *crassa* Cookson: Drozhastchich in Samoilovitch et al., p. 14; Pl. 1, fig. 2, 3.

DESCRIPTION: Microspores trilete, biconvex; amb subcircular. Laesurae straight, extending to amb of spore cavity, and enclosed within low, membraneous lips. Exine cingulate; cingulum 2·5-5 μ wide, radially striated. Proximal exine *c.* 1 μ thick, smooth. Distal exine thickened in a circular area (14-18 μ in diameter) about the distal pole; in corroded examples the peripheral region of the distal thickening is reduced to verrucae and granules.

DIMENSIONS: Equatorial diameter; overall 25 (34) 45 μ, spore cavity 18 (25) 36 μ.

COMPARISON: The distal features of the species distinguish it from *Cingutriletes congruens* Pierce and *Stereisporites megastereoides* Pflug. *Sphagnum subflavum* Bolkhovitina and Pocock's specimen (1962; Pl. 1, fig. 4) of *Sphagnumsporites psilatus* (Ross) show granules, verrucae, and a polar thickening distally, and may be conspecific with *C. clavus* (Balme).

Drozhastchich (in Samoilovitch et al. 1961) compares the species with the spores of *Sphagnum tenellum* Pers., *S. apiculatum* Lindl., and *S. cuspidatum* Ehrh.

DISTRIBUTION: The species is known from Jurassic, Cretaceous, and Tertiary strata of Australia (Cookson 1953, Balme 1957, de Jersey 1959) and the U.S.S.R. (Samoilovitch et al. 1961). It is an uncommon but widely distributed form in the Upper Mesozoic of SE. Australia (see Tables 3-9).

Genus **Murospora** Somers 1952

TYPE SPECIES: *Murospora kosankei* Somers 1952.

After an examination of the type species and following Staplin's (1960) circumscription of the genus, Pocock (1961) assigned two Upper Mesozoic species, *M. florida* (Balme) and *M. mesozoica* Pocock, to *Murospora*. These Mesozoic forms undoubtedly conform with the genus, but, as evinced herein, Pocock has misinterpreted the morphology of *M. florida*. He contends that the species is characterized by distally thickened exine (patella). However, as revealed by sections of SE. Australian specimens, its exine is cingulate (thickened in equatorial region only). Similar cingulate features have been described by Playford (1962) for several Lower Carboniferous species of *Murospora*, and sections of one of these *M. aurita* (Waltz), show that the cingulum is thickest near the equator (see Hughes et al. 1962).

Cingulate Cretaceous microspores assigned to *Trilibozonosporites rotalis* (Weyland & Krieger) and *Dicksonia paraguadia* Bolkhovitina may be comparable morphologically to *Murospora*.

Murospora florida (Balme) Pocock 1961

(Pl. XIV, fig. 9-14)

1957 *Cingulatisporites floridus* Balme, p. 26; Pl. 5, fig. 60, 61.
1961 *Murospora florida* (Balme) Pocock, p. 1233; Fig. 1, fig. 6, 7.

DESCRIPTION: Cingulate microspores trilete, biconvex; amb subtriangular to irregular. Exine composed of one, homogeneous, almost smooth, differentially thickened layer which is 5-8 μ thick in polar regions and 11-16 μ thick equatorially. Cingulum shows considerable variation in width (10-28 μ) in individual specimens; outer margin irregularly undulate, inner margin conformable with triangular amb of spore cavity. Laesurae straight to weakly sinuous, extending to inner margin of cingulum, and with elevated (3-5 μ high) lips which are 1-2 μ wide at crests.

DIMENSIONS: Equatorial diameter (22 specimens); overall 59 (79) 100 μ, spore cavity 40 (51) 67 μ.

REMARKS: Except for their greater size range, the SE. Australian specimens are identical to those described from Western Australia by Balme (1957) and Pocock (1961). The latter author states (p. 1233) that the species has a distally situated, 'thick laevigate patella 8 to 15 μ thick'; however, transverse sections (present study; Pl. XIV, fig. 13, 14) show that the exine is cingulate, and, moreover, that the proximal exine is as thick as the distal exine. The laesurate lips are composed of proximal extensions of the exine, and have narrow crests.

One of the specimens figured by Balme (1957; Pl. 5, fig. 61) has a pitted exine in the polar regions. Similar features, which are probably due to corrosion, are exhibited by some of the specimens recovered in the present investigation (Pl. XIV, fig. 11, 12). The polar exines of some specimens (see Pl. XIV, fig. 11) are with small, evenly-spaced pits; in more heavily corroded spores (Pl. XIV, fig. 12), the pits are larger and often encroach on to the cingulum where they are radially arranged.

COMPARISON: The larger size and/or wider cingulum of *Murospora florida* (Balme) distinguishes it from *M. mesozoica* Pocock, *Trilobozonosporites rotalis* (Weyland & Krieger), and *Dicksonia paraguadia* Bolkhovitina.

DISTRIBUTION: Balme (1957) indicates a Neocomian-Aptian distribution of the species in Western Australia; Pocock's (1961) Western Australian record is from the probably Neocomian-Aptian Strathalbyn Sandstone (see Balme 1957, p. 44; Table 4). In South Australia it shows restricted vertical distribution in the Great Artesian Basin and has been recovered from the Otway Basin and E. Victoria (see Tables 3, 4, 6-8).

Genus **Foraminisporis** Krutzsch 1959

TYPE SPECIES: *Foraminisporis foraminis* Krutzsch 1959.

REMARKS: The microspores here attributed to *Foraminisporis* possess a narrow, sculptured cingulum, and are not strictly applicable to the genus as diagnosed by Krutzsch (1959, p. 130). However, the Australian spores resemble closely the type species, the illustrated holotype of which appears to be weakly thickened equatorially.

It should be noted that the cingulate nature of the Australian species was recognized only after a critical examination of specimens mounted in 50% glycerine, and situated in off-polar aspects. Almost all of the specimens recorded in glycerine jelly mounts are orientated in full-polar aspect.

AFFINITY: As discussed subsequently, two of the Australian Mesozoic species closely resemble spores found in the living hepatic species *Nothylas breutelii* Gottsche and *Phaeoceros bulbiculosus* (Brotero).

Foraminisporis wonthaggiensis (Cookson & Dettmann) comb. nov.

(Pl. XIV, fig. 19-23; Fig. 4o)

1958 *Apiculatisporis wonthaggiensis* Cookson & Dettmann, p. 100; Pl. 14, fig. 7-10.
1961 *Cirratriradites* cf. *tilchaensis* Cookson & Dettmann; Samoilovitch et al.; Pl. XXXIX, fig. 6.
1962 *Lycospora cretacea* Pocock, p. 34; Pl. 1, fig. 12, 13.

DESCRIPTION: Microspores trilete, biconvex; amb subcircular, subtriangular, or occasionally subquadrangular with convex sides. Laesurae straight to undulose, extending to equator, and with membraneous lips *c.* 1 μ high. Exine spinulose, 1·5-2·5 μ thick but thicker (3-5 μ) equatorially; narrow, tapering cingulum spinulose and with a few irregularly scattered, small foveolae. Distal spinulae 1-1·5 μ in basal diameter, 1-2 μ high, and spaced 1-3 μ apart; proximal spinulae smaller, more closely spaced, and often with confluent bases.

DIMENSIONS: Overall equatorial diameter 36 (49) 61 μ.

COMPARISON: The species may be conspecific with the spore attributed by Chlonova (1961, p. 49; Pl. 4, fig. 29) to *Osmunda granulata* (Maljavikina). It is distinct from *Osmundacidites hirtus* Lantz which has shorter laesurae, and *Alsophila asperata* Bolkhovitina which has more crowded spinulae and is larger in size. *Trilites bifurcatus* Couper and *Foraminisporis foraminis* Krutzsch resemble *F. wonthaggiensis* (Cookson & Dettmann), but differ in possessing branched laesurae and more reduced proximal sculpture.

AFFINITY: Spores morphologically similar to *F. wonthaggiensis* occur in the living hepatic species *Nothylas breutelii* Gottsche, and are described in Appendix I (see also, Pl. XXVII, fig. 12-14).

Distribution: The species shows wide distribution and is of some stratigraphical value in the Upper Mesozoic of SE. Australia (Cookson and Dettmann 1958b; Dettmann 1959; present study, Tables 4-9). It is known also from Barremian strata of Canada (Pocock 1962), and in the Turonian of Siberia (Samoilovitch et al. 1961). The similar spore of *Osmunda granulata* which Chlonova (1961) recorded is from Cenomanian-Turonian deposits of Siberia.

Foraminisporis dailyi (Cookson & Dettmann) comb. nov.

(Pl. XIV, fig. 15-18)

1958 *Granulatisporites dailyi* Cookson & Dettmann, p. 99; Pl. 14, fig. 2-4.

Description: Microspores trilete, biconvex; amb subcircular, subtriangular, or subquadrangular with convex sides. Laesurae straight, extending to equator, and with membraneous, inconspicuous lips *c.* 1 μ high. Exine 1-2·5 μ thick, thicker (2-6 μ) at equator; narrow cingulum equatorially tapering and with small, shallow, irregular foveolae. Distal exine sculptured with irregularly disposed, low granules and verrucae (1-5 μ in basal diameter); proximal exine with a cluster of small, clearly defined granules on the central area of each contact face.

Dimensions: Overall equatorial diameter 36 (55) 70 μ.

Comparison: The species is similar in overall construction to *Foraminisporis wonthaggiensis* (Cookson & Dettmann) which differs, however, in possessing spinulose sculpture. The spores illustrated, but not described, by Paeltova (1961; Pl. 13, fig. 1, 2) of *Sporites* sp., and by Samoilovitch et al. (1961; Pl. XXXIX, fig. 7) of *Selaginella* sp. may be comparable to *F. dailyi* (Cookson & Dettmann). The species is distinct from *Trilites lachlanae* Couper and *Trachytriletes mixtus* Bolkhovitina both of which lack proximal sculpture.

Affinity: *F. dailyi* is similar in morphology to microspores, which are described in Appendix I (see also, Pl. XXVII, fig. 15-18), of *Phaeoceros bulbiculosus* (Brotero) and *Nothylas breutelii* Gottsche. The latter species also produces spores which are comparable to *Foraminisporis wonthaggiensis* and this may indicate that *F. dailyi* and *F. wonthaggiensis* originated in closely related plants.

Distribution: A widely dispersed species in the Upper Mesozoic of SE. Australia (Cookson and Dettmann 1958b, 1959a; Dettmann 1959; present study, Tables 4-9).

Foraminisporis asymmetricus (Cookson & Dettmann) comb. nov.

(Pl. XVI, fig. 15-19)

1958 *Apiculatisporis asymmetricus* Cookson & Dettmann, p. 100; Pl. 14, fig. 11, 12.
1958 *Todea gibva* Verbitskaya; Pl. 2, fig. 29.
1962 *Todea gilva* Verbitskaya, p. 94; Pl. 4. fig. 35a-e.
1962 *Verrucosisporites asymmetricus* (Cookson & Dettmann) Pocock, p. 56; Pl. 8, fig. 124-126.

Description: Microspores trilete, biconvex; amb asymmetrically subquadrangular to subtriangular with straight or convex sides. Laesurae inconspicuous, approximating amb, and enclosed within membraneous lips 1-2 μ high. Exine verrucate, 2-3 μ thick; thicker (4-6 μ) equatorially where a narrow, verrucate cingulum is developed. Distal and equatorial verrucae broadly rounded and 2-3 μ high in optical section; with circular to polygonal bases (2-3 μ in diameter), and spaced 1-3 μ apart. Proximal verrucae smaller (1-2 μ in basal diameter) and more sparsely distributed.

Dimensions: Overall equatorial diameter 40 (53) 70 μ.

COMPARISON: The species is readily distinguishable from *Foraminisporis wonthaggiensis* (Cookson & Dettmann) in having verrucate sculpture, and from *F. dailyi* (Cookson & Dettmann) in possessing larger and more evenly developed verrucae. *F. asymmetricus* (Cookson & Dettmann) resembles *Dicksonia bulbacea* Bolkhovitina, but is distinct in lacking verrucate, laesurate lips. *Dicksonia densa* Bolkhovitina has smaller and more crowded verrucae and *D. crocina* Bolkhovitina has larger verrucae which appear to be confined to the distal surface.

DISTRIBUTION: A widely distributed species in E. Australia (Cookson and Dettmann 1958b; Dettmann 1959; present study, Tables 4-9) where it appears to be of some stratigraphical importance. In the Great Artesian Basin its first occurrence is in the upper horizons of the Blythesdale Group, and it ranges into the Tambo Formation (Albian). Extra-Australian records include Aptian-Albian of Russia (Verbitskaya 1962) and Barremian-Aptian of Canada (Pocock 1962).

Genus **Contignisporites** gen. nov.

DIAGNOSIS: Microspores trilete, cingulate; symmetrical about a plane that includes the polar axis and which is situated either at right angles to, or parallel to, the length of the distal muri (see Fig. 5). Distal exine shows bilaterally symmetrical sculpture; sculptural elements include a series of more or less parallel, sometimes bifurcating and anastomosing muri which are coalescent with cingulum. Proximal exine radially symmetrical; with one tangentially disposed murus on equatorial region of each contact face; polar exine with or without sculpture.

TYPE SPECIES: *Contignisporites glebulentus* sp. nov.

OTHER SPECIES:

(1) *Contignisporites* (al. *Cicatricosisporites*) *cooksonii* (Balme 1957, p. 19; Pl. 1, fig. 23, 24; Pl. 2, fig. 25, 26) comb. nov.
(2) *Contignisporites fornicatus* sp. nov.
(3) *Contignisporites multimuratus* sp. nov.
(4) *Contignisporites* (al. *Aneimia*) *dorsostriatus* (Bolkhovitina 1956, p. 60; Pl. 7, fig. 95b) comb. nov. Occurrence: U.S.S.R.; Upper Jurassic-Lower Cretaceous (Bolkhovitina 1956, 1961).
(5) *Contignisporites* (al. *Cicatricosisporites*) *dunrobiensis* (Couper 1958, p. 137; Pl. 17, fig. 13-15) comb. nov. Occurrence: Britain; Lower Lias-Bajocian.
(6) *Contignisporites* (al. *Chomozonotriletes*) *mitriforminus* (Korgenevskaja) comb. nov. (see Verbitskaya 1958; Pl. 2, fig. 37, 37a: 1962, p. 100; Pl. 9, fig. 46a-g). Occurrence: U.S.S.R.; Aptian (after Verbitskaya 1962). The validity of this species is in some doubt as a holotype has not been designated in the available literature.
(7) *Contignisporites* (al. *Chomotriletes*) sp. Sah 1953, p. 3; Pl. 1, fig. 7; Pl. 2, fig. 34. Occurrence: Ceylon; Jurassic.

The illustrated specimens of *Anemia sujfunensis* Bolkhovitina (1961, p. 59; Pl. 17, fig. 5a-c) appear to be comparable morphologically to *Contignisporites* gen. nov., but according to the description the distal muri parallel the triangular amb.

DISCUSSION: This interesting group of Upper Mesozoic spores is characterized by equatorially thickened exine (cingulate), bilaterally symmetrical sculpture, and radially symmetrical proximal sculpture. Fig. 5 illustrates the distal, proximal, and overall symmetry of *Contignisporites*, and the two symmetry types recorded for each of the Australian species described below. These types differ only in the orientation (relative to the laesurae) of the distal muri; in the first type (Fig. 5a-c), the distal muri parallel one laesura and bisect the angle formed by the other two; in the second type (Fig. 5d-f), the distal muri are arranged at right angles to a laesura and bisect the angles between it and the other two laesurae. In *Contignisporites glebulentus* sp. nov. and *C. cooksonii* (Balme) both types have been recorded in approximately equivalent proportions, and this may indicate that they were derived from spore tetrads comprising two spores of each type.

The criteria largely used in the delineation of the Australian species include shape of muri, overall width of four adjacent muri and lumina in the distal polar region, proximal polar sculpture, and width of cingulum. The cingulum and sculptural elevations in some examples are cavate; the cavae, which are shown in transverse sections (Pl. XV, fig. 8-10, 17, 18), are considered to have resulted from a partial breakdown (possibly due to corrosion) of the exine. As seen in polar view, cavate specimens have a concentrically striated cingulum.

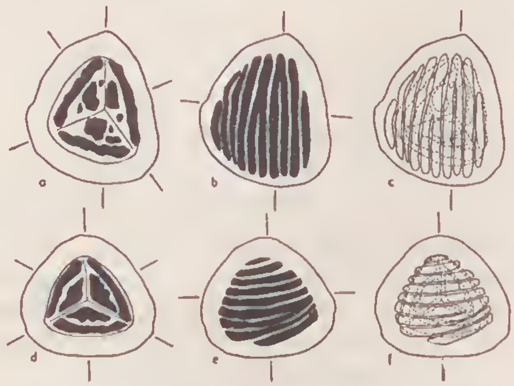

FIG. 5—Drawings from photographs illustrating proximal, distal, and overall symmetry of the two symmetry types recorded in *Contignisporites glebulentus* sp. nov. (a-c) Holotype in which the distal muri parallel one laesura and bisect the angle formed between the other two laesurae (see also Pl. XV, fig. 1-2); Penola Bore No. 1 at 1,805-15 ft, D286/5 34·9 119·6 (P22081); (d-f) Specimen in which the distal muri are arranged at right angles to one laesura and bisect the angle between it and the other two laesurae (see also Pl. XV, fig. 3, 4); Robe Bore No. 1 at 1,400 ft, D217/12 41·7 118·8 (P22082). Magnifications × *c.* 250.

COMPARISON AND AFFINITY: The cingulate feature coupled with the distal sculpture of one series of parallel muri distinguishes *Contignisporites* from *Cicatricosisporites* Potonié & Gellitich, *Plicatella* Maljavikina ex Potonié, and *Appendicisporites* Weyland & Krieger.

Bolkhovitina (1961) implies that *Contignisporites cooksonii* and *C. dorsostriatus* (Bolkhovitina) bear an affinity with *Anemia* Swartz, but, as far as the author is aware, none of the spores presently known in living and fossil species of the Schizaeaceae is comparable to *Contignisporites.*

Contignisporites glebulentus sp. nov.

(Pl. XV, fig. 1-10; Fig. 5)

DIAGNOSIS: Microspores trilete, symmetrical about one plane that includes the polar axis and which is situated either at right angles to or parallel to the length of the distal muri (Fig. 5c, f); biconvex; amb triangular, usually elongated along one median, and with straight to weakly convex sides. Exine (as seen in transverse sections) weakly differentiated into two layers; intexine *c.* 1 μ thick; sculptured exoexine cingulate, 3-4 μ thick in polar regions (inclusive of sculpture). Cingulum smooth, 9-14 μ wide; concentrically striated in corroded specimens in which it is cavate (Pl. XV, fig. 3-6). Distal exoexine with bilaterally symmetrical, cicatricose sculpture; sculptural elevations include seven to ten, parallel, occasionally bifurcating, rarely anastomosing, closely-spaced, rounded muri which coalesce with cingulum along its inner margin. Muri sometimes cavate, 3-5 μ wide, 2-3 μ high; separated by narrow (1-2 μ wide), elongated lumina; four adjacent muri and lumina total 22 μ in width. Proximal exoexine shows radially symmetrical sculpture; polar interradial regions with low (2-3 μ high), broad-based (2-14 μ in diameter), sometimes elongated verrucae; equatorial region of each contact face with one, tangentially disposed, fusiform murus, 2-3 μ high, 3-5 μ wide, and 36-46 μ long. Laesurae straight, extending to inner margin of cingulum.

DIMENSIONS: Equatorial diameter; overall 59 (68) 78 μ, spore cavity 39 (48) 56 μ. Polar diameter (3 specimens) 35 (41) 45 μ.

HOLOTYPE: Preparation D286/5 34·9 119·6 P22081; Pl. XV, fig. 1, 2; Fig. 5a-c. Proximal aspect. Amb triangular, 78 μ in diameter. Cingulum 14 μ wide. Distal surface with ten parallel muri (each 4 μ in width) that are separated by narrow (1·5 μ wide) lumina; muri parallel one laesura. Proximal polar verrucae 3-14 μ in diameter; interradial muri 4 μ wide, 40 μ long. Laesurae 28 μ long.

LOCUS TYPICUS: South Australia, Penola Bore No. 1 at 1,805-15 ft.

DISCUSSION: Fig. 5 illustrates the overall symmetry and the two types of distal sculpture patterns shown by the species. The distal muri of 18 of the 33 specimens examined are orientated at right angles to one laesura, whilst in the other 15 examples they parallel one laesura and bisect the angle formed by the other two laesurae. Transverse sections (Pl. XV, fig. 8-10) of the two-layered exine show the cavate nature of the cingulum and sculptural elevations.

COMPARISON: *Contignisporites glebulentus* sp. nov. is distinguishable from *C. dorsostriatus* (Bolkhovitina) which has wider distal muri and a subcircular amb.

DISTRIBUTION: The species appears to have restricted vertical distribution in the Otway and Great Artesian Basins. In the Oodnadatta Bore it has been recovered from the uppermost horizons of the Roma (Aptian) Formation and from samples of the Tambo (Albian) Formation (see Tables 5-7, 9).

Contignisporites cooksonii (Balme) comb. nov.

(Pl. XV, fig. 11-16)

1957 *Cicatricosisporites cooksonii* Balme, p. 19; Pl. 1, fig. 23, 24; Pl. 2, fig. 25, 26.
1961 *Anemia cooksonii* (Balme) Bolkhovitina, p. 59; Pl. 17, fig. 6b-e.
1961 non *Anemia mitriformina* Verbitskaya: Bolkhovitina, p. 59.

DESCRIPTION: Microspores trilete, symmetrical about one plane, biconvex; amb roundly triangular, sometimes elongated along one median. Exine one-layered, 3-4 μ thick in polar regions (inclusive of sculpture), thicker equatorially; cingulum 4-7 μ wide, cavate in corroded specimens. Distal exine with bilaterally symmetrical, cicatricose sculpture; sculptural elevations include six to nine, parallel, rarely bifurcating, low (2-3 μ high), rounded muri which coalesce with cingulum towards equator. Muri wider (3·5-4·5 μ) than intervening lumina (1·5-2·5 μ); four adjacent muri and lumina total 20-25 μ in width. Proximal exine shows radial symmetry; smooth about pole, and with one, low, tangentially orientated murus (3·5-4·5 μ in width) on each interradial area near inner margin of cingulum. Laesurae straight, extending to cingulum, and with thin lips *c.* 1 μ high.

DIMENSIONS: Equatorial diameter (23 specimens); overall 39 (50) 59 μ, spore cavity 31 (37) 42 μ.

Discussion and Comparison: The distal muri are disposed either parallel to (in 10 specimens) or at right angles to (in 13 specimens) one laesura (see Pl. XV, fig. 11-14). Sections (Pl. XV, fig. 17, 18) cut obliquely to the distal muri show the cavate nature of the cingulum.

Contignisporites cooksonii (Balme) is distinguishable from *C. glebulentus* sp. nov. in its lack of proximal polar sculpture, narrower cingulum, and smaller size. *C. dorsostriatus* (Bolkhovitina) shows wider distal muri, and *C. mitriforminus* (Korgenevskaja) is larger and has proximal polar sculpture.

Distribution: Balme (1957) described the species from Oxfordian-Aptian strata of Western Australia; the specimens subsequently illustrated by Bolkhovitina (1961) are from Barremian-Aptian of U.S.S.R. In SE. Australia the species has been recovered from the Blythesdale Group and Roma (Aptian) Formation in the Great Artesian Basin and from sediments in the Otway Basin and E. Victoria (Tables 3, 4, 6-8; see also Dettmann 1959).

Contignisporites fornicatus sp. nov.

(Pl. XVI, fig. 1-5)

Diagnosis: Microspores trilete, symmetrical about one plane; spheroidal, the distal surface strongly arched; amb subcircular. Exine 4 μ thick in polar regions (inclusive of sculpture), cingulate; cingulum 5-8 μ wide. Distal surface with bilaterally symmetrical, cicatricose sculpture of five to eight parallel, occasionally bifurcating, low (2-3 μ high), straight-sided, broadly-crested muri which anastomose with inner margin of cingulum. Muri wider (5-6 μ) than intervening lumina which are 2-3 μ wide; four adjacent muri and lumina total 32-35 μ in width. Proximal exine radially symmetrical; equatorial interradial area of each contact face with a tangentially disposed murus, c. 1 μ high and 4-5 μ wide; polar regions with hemispherical verrucae 2-8 μ in diameter. Laesurae straight, extending to inner margin of cingulum.

Dimensions: Equatorial diameter (12 specimens); overall 42 (53) 62 μ, spore cavity 31 (38) 46 μ. Polar diameter (2 specimens) 40, 42 μ.

Holotype: Preparation D222/11 41·5 119·3 P22088; Pl. XVI, fig. 1-3. Distal aspect. Amb subcircular, 62 μ in diameter. Laesurae 26 μ long. Cingulum 7 μ wide; distal exine with seven muri (each 5-6 μ wide) that are arranged at right angles to one laesura. Proximal muri 4·5 μ wide, 33 μ long; verrucae 2-8 μ in diameter.

Locus Typicus: South Australia, Tilcha Bore No. 2 at 460-80 ft.

Discussion and Comparison: In three of the specimens recovered, the distal muri are arranged at right angles to one laesura; in the other nine examples the distal muri parallel a laesura (cf. Fig. 5).

The species differs from *Contignisporites glebulentus* sp. nov. and *C. cooksonii* (Balme) in its subcircular amb and wider distal sculptural elements (total width of four muri and lumina); *C. dorsostriatus* (Bolkhovitina) has wider distal muri (6-9 μ).

Distribution: A rare type, recovered only from sediments of the Great Artesian Basin, South Australia (see Tables 4-6, 9).

Contignisporites multimuratus sp. nov.

(Pl. XVI, fig. 6-13)

Diagnosis: Microspores trilete, symmetrical about one plane; plano-convex, the distal surface strongly arched; amb subtriangular with convex sides. Exine one-layered, 7 μ thick in polar regions (inclusive of sculpture); thicker equatorially. Cingulum 7-10 μ wide, cavate in corroded specimens. Distal exine bilaterally symmetrical; sculpture of eleven to sixteen, more or less parallel, bifurcating and usually anastomosing, straight-sided, roundly-crested muri which coalesce with cingulum near equator. Muri 5-6 μ high, slightly wider than, or as wide as, intervening lumina (2-3 μ); four adjacent muri and lumina total 18-20 μ in width. Proximal exine radially symmetrical; with conspicuous verrucae (2-10 μ in diameter) on polar regions, and three, fusiform, tangentially disposed muri (2-3 μ high, 2-3 μ wide), which parallel interradial margin of contact faces. Laesurae straight, extending to cingulum, and with membraneous lips *c.* 1 μ high.

DIMENSIONS: Equatorial diameter (7 specimens); overall 58 (66) 76 μ, spore cavity 42 (48) 56 μ. Polar diameter (5 specimens) 42 (48) 56 μ.

HOLOTYPE: Preparation D331/1 54·4 114·5 P22057; Pl. XVI, fig. 6-8. Distal aspect. Amb subtriangular, 76 μ in diameter. Laesurae 23 μ long. Cingulum 10 μ wide, irregular in outline. Distal surface shows twelve, more or less parallel, bifurcating muri, each 3 μ in width; muri arranged parallel to one laesura. Proximal verrucae 2-10 μ in diameter.

LOCUS TYPICUS: South Australia, Cootabarlow Bore No. 2 at 1,348-52 ft.

DISCUSSION AND COMPARISON: The specimens incorporated within *Contignisporites multimuratus* sp. nov. bear distal muri which are orientated either at right angles to (in 3 specimens) or parallel to (in 5 specimens) one laesura. The muri, as seen in transverse sections (Pl. XVI, fig. 11-13), are higher and narrower than those of the other three SE. Australian species of *Contignisporites*. *C. dorsostriatus* (Bolkhovitina) has wider muri and is smaller in size. One of the specimens assigned by Verbitskaya (1962; Pl. 9, fig. 46e) to *C. mitriforminus* (Korgenevskaja) resembles *C. multimuratus*.

DISTRIBUTION: A rare type found in sediments of the Great Artesian and Otway Basins (see Tables 4, 6-8).

Genus **Kraeuselisporites** Leschik emend. Jansonius 1962

1955 *Kraeuselisporites* Leschik, p. 36.
1958 *Styxisporites* Cookson & Dettmann, p. 114.
1962 *Kraeuselisporites* Leschik emend. Jansonius, p. 46.

TYPE SPECIES: *Kraeuselisporites dentatus* Leschik 1955.

The genus was originally diagnosed (Leschik 1955) as alete, and thus no reference was made to it when Cookson and Dettmann (1958b) instituted their genus *Styxisporites* to incorporate trilete, zonate microspores with distal spinose sculpture. Jansonius (1962) subsequently recognized that the type species of *Kraeuselisporites* Leschik is trilete, and the features connoted in his emendation of the genus are comparable to those of *Styxisporites*. However, Jansonius (1962) and Balme (1963) suggest that the two genera are distinguishable on the extent and height of their laesurate lips and the density of their zona. The present writer considers that these features provide insufficient basis for the retention of *Styxisporites* as a genus distinct from *Kraeuselisporites*.

In addition to the species described by Leschik (1955), Jansonius (1962), and Balme (1963), the following Mesozoic microspores conform with *Kraeuselisporites*:

(1) *Kraeuselisporites* (al. *Styxisporites*) *linearis* (Cookson & Dettmann 1958, p. 114; Pl. 19, fig. 3, 4, 8, 9) comb. nov.
(2) *Kraeuselisporites* (al. *Styxisporites*) *majus* (Cookson & Dettmann 1958, p. 115; Pl. 19, fig. 10-13) comb. nov.

(3) *Kraeuselisporites* (al. *Selaginella*) *maturus* (Bolkhovitina 1959, p. 85; Pl. 1, fig. 10) comb. nov. Occurrence: U.S.S.R.; Upper Cretaceous.
(4) *Kraeuselisporites* (al. *Styxisporites*) *cooksonae* (Klaus 1960, p. 141; Pl. 31, fig. 29, 31) comb. nov. Occurrence: Europe; Carnian.

Mesozoic microspores assigned to *Cingulatisporites saevus* Balme may be comparable to *Kraeuselisporites*.

Kraeuselisporites linearis (Cookson & Dettmann) comb. nov.

(Pl. XVII, fig. 1-4)

1958 *Styxisporites linearis* Cookson & Dettmann, p. 114; Pl. 19, fig. 3, 4, 8, 9 (non fig. 6, 7).
1960 *Styxisporites linearis* Cookson & Dettmann: Potonié, p. 66; (non Pl. 4, fig. 69).

DIAGNOSIS: As given by Cookson and Dettmann (1958b).

DIMENSIONS: Equatorial diameter (22 specimens); overall 53 (62) 70 μ, spore cavity 42 (47) 53 μ. Width of zona 5-9 μ; maximum height of laesurate lips 5-7 μ.

HOLOTYPE: P17630 Cookson and Dettmann 1958b; Pl. 19, fig. 3, 4: present study; Pl. XVII, fig. 1, 2. Distal aspect. Amb subcircular, 59 μ in diameter. Laesurae straight, extending to inner margin of zona, and enclosed within membraneous, elevated lips; lips 6 μ high at pole, tapering to *c.* 1 μ near equator. Exine 2 μ thick, smooth proximally; with distal coni and setulae which are 7-8 μ high, 2-3 μ in basal diameter, and spaced 5-8 μ apart. Zona membraneous, 7 μ wide, and with a serrated margin.

LOCUS TYPICUS: Victoria, Wonthaggi State Coal Mine Area; Kirrak, floor of coal seam at 103 ft.

REMARKS: The holotype was incorrectly captioned in the accompanying plate explanation of Cookson and Dettmann (1958b). This error was rectified subsequently by these authors (1959d), but it has been perpetuated by Potonié (1960) who illustrates an example of *Aequitriradites spinulosus* (Cookson & Dettmann) under the name *Styxisporites* Cookson & Dettmann.

COMPARISON: The species resembles *Kraeuselisporites apiculatus* Jansonius, but has longer sculptural elements and higher lips. *K. linearis* (Cookson & Dettmann) is distinct from *K. maturus* (Bolkhovitina) and *K. dentatus* Leschik both of which are smaller in size and have smaller sculptural elements; and from *K. ramosus* Leschik which has a thicker exine and smaller coni.

DISTRIBUTION: An uncommon type showing wide lateral and restricted vertical distribution in the Upper Mesozoic of SE. Australia (Cookson and Dettmann 1958a; present study, Tables 3, 4, 6-8). In the Oodnadatta Bore, Great Artesian Basin it has been recovered from samples of the Blythesdale Group and overlying Roma (Aptian) Formation.

Kraeuselisporites majus (Cookson & Dettmann) comb. nov.

(Pl. XVII, fig. 5, 6)

1958 *Styxisporites majus* Cookson & Dettmann, p. 115; Pl. 19, fig. 10-13.

DIAGNOSIS: As given by Cookson and Dettmann (1958b).

DIMENSIONS: Equatorial diameter; overall 56 (69) 83 μ, spore cavity 42 (51) 64 μ. Polar diameter (2 specimens) 25, 36 μ. Width of zona 9-17 μ; maximum height of laesurate lips 7-12 μ.

COMPARISON: *Kraeuselisporites majus* (Cookson & Dettmann) is distinct from other members of the genus in the form and arrangement of its distal sculptural elements. It resembles the spores of *Selaginella pedata* Klotzsch which differ, however, in having proximal sculpture (see Knox 1950, p. 249; Pl. 11, fig. 88a, b).

DISTRIBUTION: The species is widely distributed in Australian Upper Mesozoic sediments where it seems to have stratigraphical importance. It is known from the Albian of Western Australia, Queensland, and the Great Artesian Basin (South Australia and New South Wales); and has been recovered from certain horizons of the Otway Basin (Cookson and Dettmann 1958b; present study, Tables 5-7, 9).

Genus **Minerisporites** Potonié 1956

TYPE SPECIES: *Minerisporites mirabilis* (Miner) Potonié 1956.

Minerisporites marginatus (Dijkstra) Potonié 1956

(Pl. XVI, fig. 14)

DIMENSIONS: Overall equatorial diameter (6 specimens) 240 (310) 375 μ.

DISTRIBUTION: The species was described from the Wealden of the Netherlands (Dijkstra 1951), and subsequently reported from the Ashdown Sands (Valanginian) of England (Hughes 1958) and Upper Mesozoic strata of E. Australia (Cookson and Dettmann 1958a, 1958b; Dettmann 1959; present study, Tables 3-9).

Suprasubturma PERINOTRILITES Erdtman emend.

Perinotrilites Erdtman is emended to incorporate trilete spores which are characterized by a cavate sclerine of uniform or differential thickness. The laesurae may be simple or lipped.

REMARKS AND COMPARISON: As defined above this category includes certain of the trilete spores previously attributed to Monosaccites Chitaley and to Perinotrilites Erdtman sensu Potonié (1956).

The name Perinotrilites was first introduced by Erdtman (1947, p. 111) who stated that 'fossil spores with a distinct perine may be referred to Perinotrilites'. Potonié (1956) subsequently applied the name to a suprageneric category which was diagnosed to incorporate perinate, trilete *sporae dispersae*. The assignment of fossil spores to Perinotrilites Erdtman sensu Potonié is dependent, therefore, upon the presence of a perine, a wall layer that is often difficult to distinguish even in recent spores (Erdtman 1947, 1952; Harris, W. F. 1955). Nevertheless, Perinotrilites was used by several authors for fossil spores of Palaeozoic and Mesozoic age. Few of these spores are certainly perinate, but many possess a membraneous outer wall layer which loosely envelopes the inner wall layer (s). Spores exhibiting these features are here termed 'cavate', and the outermost wall layer of cavate spores is denoted by 'outer layer of sculptine' rather than by 'perine' (see Glossary of Descriptive Terms).

Trilete spores possessing a cavate sclerine have also been attributed to Monosaccites, and these conform with Perinotrilites Erdtman emend. They are readily distinguishable from definite monosaccate forms that exhibit a proximal trilete mark e.g., *Nuskoisporites dulhuntyi* Potonié & Klaus) on the following characters:

(a) the wall layers in saccate forms are attached both proximally and distally; in cavate forms the wall layers are usually only attached either about the proximal laesurae or distally;

(b) the distal polar exine of saccate forms usually is thinner and less conspicuously patterned than the proximal exine; the sclerine of described cavate forms is either uniformly patterned or more strongly patterned on the distal surface;

(c) the equatorial exoexine of saccate forms has small structural elements ('baculoid or endosexinous rods' of Erdtman 1952; 'columellae' of Faegri and Iverson 1950) attached to its undersurface; comparable structural elements are not known in trilete, cavate spores.

It should be noted that the diagnosis of Membraniti Neves conforms with Perinotrilites, but the two genera included within Neves's (1961) category do not convincingly show a cavate sclerine.

The following selected forms are comparable morphologically to Perinotrilites: *Endosporites* Wilson & Coe, *Diaphanospora* Balme & Hassell, *Velosporites* Hughes & Playford, *Spinozonotriletes* Hacquebard, *Densoisporites* Weyland & Krieger, and *Crybelosporites* gen. nov. Some of these genera include spores in which the outer layer of the cavate sclerine is equatorially thickened (e.g., *Densoisporites* and certain species of *Endosporites*), while in other described species (e.g. *Velosporites echinatus* Hughes & Playford, *Diaphanospora* spp.) the sclerine is of uniform thickness. The presence of equatorial thickening provides a basis for subdivision of Perinotrilites, but subdivision is not proposed here since many of the constituent genera are in need of revision.

Genus **Crybelosporites** gen. nov.

Diagnosis: Microspores trilete, spheroidal to ellipsoidal. Sclerine stratified; consisting of a smooth, homogeneous, inner layer enclosed within a two-layered, proximally cavate, structured sculptine. Outer layer of sculptine without a trilete aperture; proximally detached from trilete, inner layers; and with a reticulate, rugulate, or foveolate (OL) surface pattern.

Type Species: *Crybelosporites striatus* (Cookson & Dettmann) comb. nov.

Comparison: *Crybelosporites* gen. nov. is distinct from *Perotrilites* Erdtman ex Couper in having a proximally cavate, structured sculptine which has a reticulate to foveolate surface pattern. It shows superficial resemblance to *Dictyotosporites* Cookson & Dettmann, but is readily distinguishable by its stratified, proximally cavate sculptine. *Densoisporites* Weyland & Krieger is cingulate and its sclerine layers are attached about the proximal pole.

Mesozoic microspores assigned to *Hymenozonotriletes platychilus* (Maljavikina), *Selaginella asperrima* Bolkhovitina, *Salvinia perpulchra* Bolkhovitina, and *S. sangarensis* Bolkhovitina show some resemblance to *Crybelosporites*. Krutzsch's (1962) Tertiary species, *Hydrosporis*? *tectatus* and *H.*? *sinotectatus*, are almost certainly comparable to *Crybelosporites*.

Discussion and Affinity: Cookson and Dettmann (1958a) have demonstrated that the type species bears a close relationship both to dispersed megaspores included within *Pyrobolospora reticulata* Cookson & Dettmann and to microspores borne by several living species of the Marsiliaceae. The microspores of *Pilularia* L., *Marsilea* L., and *Regnellidium* Lind. are perinate, and their structured perine (which is devoid of a trilete aperture and which has a reticulate, rugulate, or foveolate surface) is proximally detached from the trilete, stratified exine. Similar, if not identical, features are shown by all three species of *Crybelosporites* recovered during the present study. Despite these morphological and structural analogies the term 'perine' is not used herein to definite the outermost, proximally detached layer of the fossil spores; instead, this layer is denoted by 'outer layer of sculptine'.

Crybelosporites striatus (Cookson & Dettmann) comb. nov.

(Pl. XVIII, fig. 1-6)

1958 *Perotrilites striatus* Cookson & Dettmann, p. 43; Pl. 1, fig. 8-12.

DESCRIPTION: Microspores trilete, spheroidal. Sclerine stratified, cavate proximally, 4-5 μ thick (inclusive of sculptural/structural elements); consisting of a smooth, homogeneous, inner layer (1-1·5 μ thick) and a ruffled, proximally cavate, two-layered sculptine, the outer layer of which forms a conical gula-like projection over the proximal pole. Sculptine 3 μ thick in optical section, striated proximally, reticulate distally and equatorially; reticulum composed of membraneous muri (1·5-3 μ high) which enclose circular to polygonal lumina 1-3 μ in diameter. Laesurae developed on two inner wall layers only; straight, length $\frac{3}{4}$ spore radius, and with weakly thickened lips.

DIMENSIONS: Equatorial diameter 28 (37) 45 μ; polar diameter 34 (45) 56 μ; diameter of inner layer 20 (29) 29 μ.

AFFINITY: Cookson and Dettmann (1958a, b) have discussed fully the possible affinity of *Crybelosporites striatus* (Cookson & Dettmann) both with Cretaceous megaspores, *Pyrobolospora reticulata* Cookson & Dettmann, and with microspores of the living Marsiliaceae (*Pilularia novaezealandiae* T. Kirk, *P. novae-hollandiae* A. Braun, and *Regnellidium diphyllum* Lindley).

DISTRIBUTION: *C. striatus* is of widespread distribution in E. Australia where it is of undoubted stratigraphical importance. Its northerly occurrences include the Albian of New Guinea and Queensland, and in SE. Australia it has been widely recognized in deposits from New South Wales, South Australia, and Victoria (Cookson and Dettmann 1958a, 1958b, 1959a; Dettmann 1959; present study, Tables 4-9). In the Great Artesian Basin it first appears in the upper horizons of the Roma Formation (Aptian), with a vertical extension into the Winton Formation (?Cenomanian).

Crybelosporites punctatus sp. nov.

(Pl. XVIII, fig. 7-11)

DIAGNOSIS: Microspores trilete, spheroidal. Sclerine 3-4 μ thick, stratified, cavate proximally; consisting of a thin (1 μ thick), homogeneous, inner layer and a thicker (2-3 μ thick), enveloping, two-layered, structural sculptine. Sculptine layers adherent distally and cavate proximally; inner layer composed of randomly arranged granules; outer layer minutely pitted (OL surface pattern) and additionally striated in proximal regions where it forms a gula-like projection over the pole. Laesurae developed on two inner layers only; straight, length $\frac{2}{3}$ spore radius, and with weakly thickened lips.

DIMENSIONS: (12 specimens) Equatorial diameter 36 (51) 64 μ; polar diameter 42 (60) 78 μ; diameter of inner layer 31 (42) 53 μ.

HOLOTYPE: Preparation D383/1 37·5 128·5 P22105; Pl. XVIII, fig. 7, 8. Equatorial aspect. Microspore spheroidal; equatorial diameter 36 μ, polar diameter 53 μ. Sclerine 3 μ thick. Sculptine 2 μ thick; with granulate structure and a punctate surface.

LOCUS TYPICUS: South Australia, Oodnadatta Bore No. 1 at 248 ft.

COMPARISON: *Crybelosporites punctatus* sp. nov. is distinguishable from both *C. striatus* (Cookson & Dettmann) and *C. stylosus* sp. nov. by the punctate surface of its sculptine. It resembles the microspores of *Marsilea* L., e.g. those of *M. aegyptiaca* Willd. (see Erdtman 1957, p. 80; Fig. 145).

DISTRIBUTION: The species is of rare occurrence in some samples from the Great Artesian and Otway Basins (see Tables 4-7, 9).

Crybelosporites stylosus sp. nov.

(Pl. XVIII, fig. 12-20)

DIAGNOSIS: Microspores trilete; plano-convex, the distal surface strongly convex. Uncompressed specimens with a circular to subcircular amb; compressed specimens irregular in equatorial outline. Sclerine 5-9 μ thick, stratified, cavate; consisting of an inner, unsculptured, homogeneous layer (1-2·5 μ thick) and a thicker, enveloping, two-layered, structured, proximally cavate sculptine. Inner layer of sculptine 2-4 μ thick, finely spongeous in structure; outer layer 1-3 μ thick, composed of radially arranged fibrous elements that form a surface reticulum composed of narrow muri and polygonal to circular lumina (1-2 μ in diameter). Sculptine layers adherent distally, elsewhere they are separated by a cavity. Laesurae straight, approximating amb of inner layer; not developed on outermost layer.

DIMENSIONS: Equatorial diameter (19 specimens); overall 50 (61) 78 μ, inner layer 36 (43) 56 μ. Polar diameter (6 specimens); overall 47 (53) 57 μ, inner layer 36 (37) 39 μ.

HOLOTYPE: Preparation D302/1 23·8 113·0 P22002; Pl. XVIII, fig. 12, 13. Distal aspect. Amb circular 54 μ in diameter; inner layer 38 μ in diameter. Smooth, homogeneous, inner layer 1·5 μ thick. Inner layer of sculptine 3 μ thick; proximally detached from outermost layer which is 1·5 μ thick. Laesurae 17 μ long.

LOCUS TYPICUS: South Australia, Cootabarlow Bore No. 2 at 1,469-70 ft.

REMARKS AND COMPARISON: Transverse sections (Pl. XVIII, fig. 19, 20) clearly show the stratified and cavate nature of the sclerine. Similar morphological and structural features are exhibited by the microspores of *Pilularia globulifera* L. that are precisely depicted by Erdtman (1957, p. 87; Fig. 162).

Crybelosporites stylosus sp. nov. differs from *C. striatus* (Cookson & Dettmann) in having a thicker sclerine and a larger size. It resembles superficially *Dictyotosporites complex* Cookson & Dettmann but is readily distinguishable by its cavate sclerine, smaller-meshed reticulum, and longer laesurae. *Hymenozonotriletes platychilis* (Maljavikina) and Bolkhovitina's species, *Selaginella asperrima* and *Salvinia sengarensis*, are distinct in having shorter laesurae, whilst *S. perpulchra* Bolkhovitina differs in its radially striated proximal surface.

DISTRIBUTION: Recovered from several samples of the Blythesdale Group in the Great Artesian Basin and in certain horizons of the Otway Basin and E. Victoria (see Tables 3, 6-8).

Genus **Velosporites** Hughes & Playford 1961

TYPE SPECIES: *Velosporites echinatus* Hughes & Playford 1961.

Velosporites triquetrus (Lantz) comb. nov.

(Pl. XIX, fig. 1-3)

1958 *Laricoidites triquetrus* Lantz, p. 926; Pl. 5, fig. 51-54.

DESCRIPTION: Microspores indistinctly trilete, biconvex; amb circular in uncompressed specimens, irregular in compressed specimens. Exine two-layered;

consisting of a thin (*c.* 1 μ thick), finely echinate intexine and a membraneous, punctate exoexine. Intexine loosely enveloped within exoexine, particularly at the equator. Laesurae straight, extending to periphery, and with membranous, elevated lips *c.* 1 μ high.

DIMENSIONS: Equatorial diameter; overall 48 (60) 70 μ, intexine 28 (39) 50 μ.

REMARKS AND COMPARISON: Although *Velosporites* Hughes & Playford has hitherto been recorded only from Carboniferous sediments, there is no morphological basis for the erection of a new genus to accommodate the Mesozoic spores described above. *Laricoidites* Potonié, Thomson, & Thiergart is alete, and its type species possesses a one-layered exine. *Velosporites triquetrus* (Lantz) is distinct from *Perinopollenites elatoides* Couper which has a monoporate, scabrate exine.

DISTRIBUTION: Lantz (1958b) described the species from Bathonian-Kimeridgian strata of England. It is of infrequent occurrence in the majority of the samples examined from the Upper Mesozoic of SE. Australia (see Tables 3-8).

Genus **Densoisporites** Weyland & Krieger emend.

1953 *Densoisporites* Weyland & Krieger, p. 12.
1961 *Selaginella* Spring: Krasnova (pars) in Samoilovitch et al., p. 19.

EMENDED DIAGNOSIS: Microspores trilete. Spore wall (sclerine) two-layered, cavate; consisting of an outer structured layer (sculptine) loosely enveloping, but proximally attached to, a thinner inner layer. Sculptine equatorially thickened, and with a finely patterned surface, the pattern being formed by an arrangement of the structural elements (but not of sculptural elements which are lacking). Inner layer thin, smooth, and with interradial thickenings (papillae) situated near the proximal pole.

TYPE SPECIES: *Densoisporites velatus* Weyland & Krieger 1953, p. 12; Pl. 4, fig. 12-14 emend. Krasnova 1961, p. 35 (=*Densoisporites perinatus* Couper 1958, p. 145; Pl. 23, fig. 6-9). A detailed consideration of this species is given subsequently.

OTHER SPECIES: (1) *Densoisporites triradiatus* Delcourt & Sprumont 1955, p. 42; fig. 11. Occurrence: Belgium; Wealden. Holotype. Delcourt and Sprumont 1955, fig. 11; Delcourt et al. 1963; Pl. 45, fig. 7. Proximal aspect. Microspore biconvex with subcircular amb, 125 μ in diameter. Laesurae straight, extending to periphery, and with membraneous, elevated (3 μ high) lips. Sclerine two-layered, cavate; sculptine with spongeous structure, 8 μ thick but thicker at equator where a tapering cingulum (25 μ wide) is developed. Sculptine loosely envelops smooth, thin (1 μ thick), inner layer which has three, low, interradial, proximal thickenings that are elliptical in outline and 10 μ in maximum diameter. The other specimen depicted by Delcourt et al. (1963; Pl. 45, fig. 8, 9) is smaller (96 μ) than the holotype (which is corroded), but it shows more clearly the sculptine features. (2) *Densoisporites* (al. *Lundbladispora*) *playfordi* Balme 1963, p. 23; Pl. 5, fig. 4-8) comb. nov. Occurrence: Western Australia; Lower Triassic.

DISCUSSION: Weyland and Krieger (1953, p. 12) validly instituted the genus (on the basis of *Densoisporites velatus*) to incorporate trilete microspores in which the cingulum is 'laminated on the inside, irregularly and finely wrinkled on the outside'. Delcourt and Sprumont (1955) added their species, *D. triradiatus*, to the genus but did not elaborate on the generic diagnosis which was later restated by Potonié (1956) and Krutzsch (1959). Couper (1958) made no mention of the cingulate (generic) feature when he described his species, *D. perinatus*, which

Krasnova (in Samoilovitch et al. 1961) subsequently included within the type species. Both Couper and Krasnova recognized that the spores are characterized by a two-layered wall, but Krasnova's description more fully clarifies the morphology of *D. velatus*. She demonstrated that it shows an equatorially thickened outer layer loosely enveloping a smooth inner layer which has proximal interradial thickenings. These morphological features were not incorporated in the generic diagnosis, however, as Krasnova attributed the type species (and the genus) to *Selaginella* Spring, a procedure which has not been adopted by the present writer.

The non-committal term 'sculptine' is used in the above generic emendation to designate the outer, loosely enveloping layer of the spore wall (sclerine) instead of 'perine' which Couper, Krasnova, and others have used in describing the same wall layer. The emendation is based upon an examination of Australian spores referable to the type species, *D. velatus*, and of the type material of *D. perinatus* (= *D. velatus*) and *D. triradiatus*.

Comparison and Affinity: *Densoisporites* Weyland & Krieger resembles *Lundbladispora* Balme (1963), which differs, however, in having distal 'cones, spines or grana'. Perhaps the closest morphological and structural analogies are to be found in certain species of *Endosporites* Wilson & Coe. In both *Endosporites globiformis* (Ibrahim) and *E. papillosus* Jansonius the two-layered, cavate wall consists of a thin, smooth, inner layer (central body) which has proximal, interradial papillae and which is proximally atached to the structured outer layer ('saccus'). In *E. globiformis* the outer layer is equatorially thickened (limbate). *Densoisporites* exhibits these features, but is distinguishable from *Endosporites* in possessing a thicker outer layer (which is more strongly thickened at the equator) together with a considerably smaller cavity between the two wall layers.

It is of considerable interest to note that a lycopodiaceous affinity has been suggested for both *Densoisporites playfordi* and *Endosporites globiformis*. Chaloner (1953, 1958) demonstrated that *E. globiformis* is comparable to the microspores of the lycopod cone *Polysporia mirabilis* Newberry (= *Lepidostrobus zea* Chaloner), and Balme (1963) suggested a lycopodiaceous, possibly selaginellid, affinity for *D. playfordi* after comparing the species with the microspores associated with *Selaginellites polaris* Lundblad.

Densoisporites velatus Weyland & Krieger emend. Krasnova 1961

(Pl. XIX, fig. 4-8)

1953 *Densoisporites velatus* Weyland & Krieger, p. 12; Pl. 4, fig. 12-14.
1958 *Densoisporites perinatus* Couper, p. 145; Pl. 23, fig. 6-9.
1958 *Dictyotosporites complex* Cookson & Dettmann (pars), p. 107; Pl. 18, fig. 1.
1961 *Selaginella velata* (Weyland & Krieger) Krasnova in Samoilovitch et al., p. 35-36; Pl. 7, fig. 5, 6.

Description: Microspores trilete, biconvex; amb roundly triangular to subcircular. Laesurae straight or slightly sinuous, length $\frac{2}{3}$-$\frac{3}{4}$ amb radius; enclosed within membraneous, low lips. Sclerine two-layered, cavate; consisting of a thin, homogeneous, inner layer and a loosely enveloping, but proximally attached, structured sculptine. Sculptine 2-3 μ thick, thicker equatorially; equatorial thickening (cingulum) 3-4 μ wide interradially and up to 6 μ wide radially. Sculptine composed of randomly arranged structural elements which are more widely spaced towards outer surface; surface pattern scabrate overall; low, sinuous, radial folds on proximal surface only. Inner layer smooth, *c.* 1 μ thick; with three, low, proximally situated, interradial polar thickenings (papillae) which are circular to elliptical in outline and 3-5 μ in maximum diameter.

DIMENSIONS: Equatorial diameter (26 specimens); overall 53 (69) 86 μ, inner layer 42 (53) 68 μ. Polar diameter (2 specimens) 30 μ, 45 μ.

COMPARISON: The Australian specimens are larger than those described by Weyland and Krieger (1953), but are similar in size to those recorded by Couper (1958), Chlonova (1961), and Krasnova (in Samoilovitch et al. 1961). *Densoisporites triradiatus* Delcourt & Sprumont is larger and has a wider cingulum; *D. playfordi* (Balme) posseses a more finely textured sculptine and a narrower cingulum. Bolkhovitina's species *Hymenozontriletes utriger, Selaginella utrigera,* and *Salvinia perpulchra* resemble *D. velatus* Weyland & Krieger but differ in showing an uniformly thick, membraneous, outer wall layer.

Potonié (1956) suggested a comparison of the species with the microspores of *Selaginella hallei* (Lundblad) and *Selaginella scandens* Spring, but *D. velatus* is clearly distinct from these spores. Except for its considerably thicker sculptine, *D. velatus* resembles the microspores associated with *Selaginellites polaris* Lundblad.

DISTRIBUTION: Weyland and Krieger described the species from Senonian strata near Aachen, Germany. It was recorded subsequently from Lower Lias-Aptian of Britain (Couper 1958); from ?Neocomian of U.S.A. (Groot and Penny 1960); and from Valanginian-Danian only of W. Siberia (Samoilovitch et al. 1961; Chlonova 1961). In SE. Australia *D. velatus* is more common in samples from the Great Artesian Basin; it has been recovered also from some horizons in the Otway Basin (see Tables 3-9).

TURMA MONOLETES Ibrahim 1933

The spores of this group are characterized by a proximal monolete aperture which has its centre at the pole; the aperture (laesura) may be simple or lipped, the lips constituting thickened and/or upturned extensions of the proximal sclerine. Monolete spores usually show bilateral symmetry.

Classification of monolete spores, as proposed here (see Table 2), is based, firstly, on the stratification of the sclerine, secondly, on the presence (or absence) of equatorial thickening and/or extension, and thirdly, on sculptural features.

Suprasubturma ACAVATOMONOLETES s.s. turma nov.

Acavatomonoletes is proposed here to incorporate monolete spores possessing an acavate sclerine.

Monolete spores having a cavate sclerine are referred by Potonié (1956) to Perinomonoliti Erdtman, and certain species assigned to Zonomonoletes Luber? appear to possess a cavate sclerine (e.g., *Saturnisporites* Klaus, *Aratrisporites* Leschik).

Subturma AZONOMONOLETES Luber 1935

Monolete spores possessing an acavate sclerine which is of uniform thickness are included within Azonomonoletes Luber.

Potonié (1956) diagnosed Zonomonoletes to incorporate monolete forms having an equatorially thickened and/or extended sclerine, but none of the types assigned to this group is convincingly equatorially thickened or extended.

Infraturma LAEVIGATOMONOLETI Dybová & Jachowicz 1957

Smooth, monolete spores possessing an acavate sclerine are incorporated within this infraturma.

Genus **Laevigatosporites** Ibrahim 1933

TYPE SPECIES: *Laevigatosporites vulgaris* (Ibrahim) Ibrahim 1933.

Laevigatosporites ovatus Wilson & Webster 1946

(Pl. XIX, fig. 9-11)

SELECTED SYNONYMY:

1946 *Laevigatosporites ovatus* Wilson & Webster, p. 273; Fig. 5.
1947 *Monolites minor* Cookson, p. 135; Pl. 15, fig. 57.
1956 *Polypodiaceaesporites minor* (Cookson) Potonié, p. 76.

DIMENSIONS: Equatorial diameter; length 31 (40) 50 μ, breadth 20 (27) 36 μ. Polar diameter 20 (26) 34 μ.

DISTRIBUTION: A widely distributed type in the Upper Mesozoic of SE. Australia (see Tables 4-7, 9); it appears to be confined to the Tambo (Albian) and Winton (?Cenomanian) Formations of the Upper Mesozoic succession in the Great Artesian Basin. Similar, if not identical, spores have been recorded frequently from other parts of the world in sediments ranging from Devonian to Recent.

Infraturma SCULPTATOMONOLETI Dybová & Jachowicz 1957

Monolete, acavate spores with a sculptured sclerine are allocated to this infraturma.

Genus **Reticuloidosporites** Pflug 1953

TYPE SPECIES: *Reticuloidosporites dentatus* (Pflug) Pflug 1953.

Krutzsch (1959) has broadened Pflug's (in Thomson and Pflug 1953) original circumscription of *Reticuloidosporites*, and has proposed three subgeneric categories of the genus. The type species (and the type subgenus *Reticuloidosporites*) is characterized by a sculpture of narrow, elongated elevations which anastomose to form a perfect or imperfect, positive reticulum. On the other hand, the subgenus *Polypodiisporites* Potonié has broadly-based, closely-spaced, low verrucae, the narrow interstices of which connect to form a negative reticulum; and the third subgenus *Accusosporis* Krutzsch shows a sculpture of intercommunicating foveolae. The present writer considers that both *Polypodiisporites* and *Accusosporis* are generically distinct from *Reticuloidosporites* which is used herein in the original sense of Pflug.

Reticuloidosporites arcus (Balme) comb. nov.

(Pl. XIX, fig. 12-14)

1957 *Polypodiidites arcus* Balme, p. 28; Pl. 6, fig. 67.

DESCRIPTION: Microspores monolete, bilateral; concavo-convex in full polar view; amb broadly elliptical to subcircular. Laesura straight, length $\frac{2}{3}$ that of major equatorial axis. Exine 2-3 μ thick; with narrow, low, sinuous muri which terminate freely or anastomose to enclose polygonal lumina 1-3 μ in diameter.

DIMENSIONS: (7 specimens) Equatorial diameter; length 42 (44) 48 μ, breadth 39 (40) 42 μ. Polar diameter 31 (32) 34 μ.

COMPARISON: *Reticuloidosporites inflexus* (Bolkhovitina) and *R. dentatus* Pflug differ in having a coarser-meshed reticulum.

DISTRIBUTION: Described by Balme (1957) from Jurassic and Lower Cretaceous strata of Western Australia, and recorded herein in samples from the Great Artesian and Otway Basins (see Tables 4, 6-8).

Genus **Microfoveolatosporis** Krutzsch 1959

TYPE SPECIES: *Microfoveolatosporis pseudodentatus* Krutzsch 1959.

This genus embraces azonate, monolete microspores having foveolate sculpture, and it is morphologically similar to the foveo-reticulate types species of *Reticulosporis* Krutzsch and *Retimonolites* Pierce. Tertiary spores included within the latter two genera are comparable to some spores of *Schizaea* J. E. Smith, whilst the Mesozoic spores here attributed to *Microfoveolatosporis canaliculatus* sp. nov. resemble the deviating spores of *Schizaea pectinata* (L.) that are described by Selling (1944, p. 22; Pl. 1, fig. 5, 6).

Microfoveolatosporis canaliculatus sp. nov.

(Pl. XIX, fig. 15-21)

DIAGNOSIS: Microspores bilateral, monolete; concavo-convex in full equatorial view; amb broadly elliptical. Laesura straight, simple, length ½ that of the major amb axis. Exine 1·5-2 μ thick, foveolate to foveo-reticulate; with circular to irregular, unevenly disposed, intercommunicating foveolae that are 1-3 μ in diameter and 0·5-1 μ deep.

DIMENSIONS: (17 specimens) Equatorial diameter; length 28 (32) 39 μ, breadth 18 (22) 26 μ. Polar diameter 14 (20) 25 μ.

HOLOTYPE: Preparation D386/2 32·1 112·7 P22115; Pl. XIX, fig. 15, 16. Oblique lateral aspect. Equatorial diameter (length) 34 μ; polar diameter 22 μ. Exine 2 μ thick.

LOCUS TYPICUS: South Australia, Cootabarlow Bore No. 2 at 581 ft.

COMPARISON: *Reticulosporis candidus* (Bolkhovitina) has larger and more regularly arranged sculptural elements. The deviating spores that are described by Selling (1944) of *Schizaea pectinata* show a similar sculpture pattern but are larger in size.

DISTRIBUTION: Recognized only in samples from the Tambo Formation (Albian) of the Great Artesian Basin (see Tables 5, 6, 9).

TURMA HILATES turma nov.

Hilates is proposed here for spores with structural and/or sculptural modification at and about the distal or proximal pole where a hilum may be developed as the result of a natural sclerinous breakdown. The proximal sclerine may possess a tetrad mark comprising three radial ridges.

The spores of this group are readily distinguishable from trilete and monolete forms on the form of their polar aperture (hilum). The hilum may be developed either proximally (*Couperisporites tabulatus* sp. nov.) or distally (*Aequitriradites* Delcourt & Sprumont).

Some described forms comprising this group exhibit a cavate sclerine (e.g., *Rouseisporites* Pocock), whilst others are acavate (*Coptospora* gen. nov., *Cooksonites* Pocock). Further, the sclerine may be azonate (*Coptospora*) or zonate (*Aequitriradites, Couperisporites* Pocock). The presence of these features indicates that Hilates may be classified on the same basis as Triletes and Monoletes, but no formal subdivision of the group is proposed here.

Genus **Coptospora** gen. nov.

1962 *Cooksonites* Pocock (pars), p. 54.

DIAGNOSIS: Microspores tetrahedral, inaperturate or hilate. Exine characterized by a modification of structure and/or sculpture at and about one (?distal) pole where a hilum may be formed as a result of a natural exinous breakdown. Sculptural/structural elements various. Membraneous, outer layer of sclerine, if represented, impersistent.

TYPE SPECIES: *Coptospora striata* sp. nov.

OTHER SPECIES:

(1) *Coptospora* (al. *Cingulatisporites*) *paradoxa* (Cookson & Dettmann 1958, p. 100, Pl. 17; fig. 9-13) comb. nov.

(2) *Coptospora* (al. *Cooksonites*) *reticulata* (Pocock 1962, p. 55; Pl. 8, fig. 118-120) comb. nov. Occurrence: Canada; Barremian.

Two other types are described subsequently from the SE. Australian Upper Mesozoic sediments, but insufficient examples have been obtained for the institution of formally named species.

The polar morphology of the Mesozoic forms referred to *Orbipatella scrutinaeformis* Maljavikina, *Chasmatosporites apertus* (Rogalska), and *Tasmanites* cf. *tardus* Eisenack (in Reinhardt 1962) has not been precisely defined; thus, their detailed comparison with *Coptospora* is precluded.

COMPARISON AND AFFINITY: On morphological grounds, the present writer considers it necessary to separate formally 'Groups I and II' of *Cooksonites* Pocock. Thus, *Coptospora* gen. nov. is instituted to incorporate Group II (acingulate species, such as *Cooksonites reticulatus* Pocock); *Cooksonites* is emended subsequently, and thereby restricted to the cingulate but otherwise similar types (Group I). *Aequitriradites* Delcourt & Sprumont differs from both genera in having an equatorially tapering membraneous 'zona'.

Polar features comparable to those of *Coptospora, Cooksonites,* and *Aequitriradites* are shown by certain modern hepatic spores which germinate by means of a rupture in, and after a breakdown of, their polar (distal) exine (see Duthie and Garside 1936, Fulford 1956, Udar 1957). Moreover, many of the modern spores borne by the Sphaerocarpaceae, Ricciaceae, and Riellaceae are hilate, and some of these are morphologically similar to *Coptospora.* In particular, the spores of *Geothallus tuberosus* Campbell resemble the dispersed spores herein assigned to *Coptospora striata* sp. nov., and it is tempting to infer a related origin of the fossil spores.

Coptospora striata sp. nov.

(Pl. XX, fig. 1-5)

DIAGNOSIS: Microspores inaperturate or hilate, biconvex; amb circular to subcircular. Exine 2-5 μ thick; smooth to faintly patterned (LO) on one hemisphere. Exine of other hemisphere (?distal) radially striated near equator; thinner (1-2 μ thick) and radially fractured in a $\pm$ circular area (30-40 μ in diameter) at and about the pole. Radially fractured, polar area composed of discrete, minute granules at pole and narrow, sinuous, radially elongated elements towards periphery; occasionally an irregular rupture (hilum) is formed by the breakdown of the exine in this area. A thin, granulate, ruffled, outer sclerinous layer loosely envelops some specimens.

DIMENSIONS: Equatorial diameter 56 (78) 100 μ; polar diameter (3 specimens) 48-78 μ.

HOLOTYPE: Preparation D225/10 34·3 117·3 P22117; Pl. XX, fig. 1, 2. Proximal (?) aspect. Amb subcircular, 86 μ in diameter. Exine 4 μ thick at equator; one surface radially fractured, and with an irregular rupture in an elliptical area (45 μ in diameter) about the pole.

LOCUS TYPICUS: South Australia, Robe Bore No. 1 at 2,630 ft.

REMARKS AND COMPARISON: Specimens (Pl. XX, fig. 5) mounted in equatorial aspect show that the exine is unthickened at the equator. The species differs from *Coptospora reticulata* (Pocock) comb. nov. which has a thicker, reticulate exine.

C. striata sp. nov. resembles the thick-walled spores of *Geothallus tuberosus* Campbell, but these modern spores (which, by kind permission of Professor G. Erdtman, have been examined by the writer) differ in showing a reticulate pattern at and about one pole (see Erdtman 1957, p. 109; Fig. 216).

DISTRIBUTION: The species is common in a few samples from the Otway Basin, and occasional specimens were found in samples from E. Victoria (see Tables 4, 5, 7, 9).

Coptospora paradoxa (Cookson & Dettmann) comb. nov.

(Pl. XXI, fig. 1-7)

1958 *Cingulatisporites paradoxus* Cookson & Dettmann, p. 100; Pl. 17, fig. 9-13.

DESCRIPTION: Microspores tetrahedral, inaperturate or hilate, biconvex; amb subtriangular to subcircular. Exine 1·5-3 μ thick, scabrate; distal exine only fractured at and about pole. Fractures delimit hexagonal areas, 5-7 μ in diameter and numbering three to nine in any one specimen; in some specimens the distal polar exine is ruptured (hilate). Proximal exine inaperturate and rarely with faint tetrad mark. Exine occasionally enveloped within a thin (1 μ thick), granulate, outer, sclerinous layer.

DIMENSIONS: Equatorial diameter 40 (53) 62 μ.

REMARKS: Sections (Pl. XXI, fig. 5-7) show that the one-layered exine is not thickened equatorially, and that it is partially traversed by fractures in the distal polar area. These sections were obtained from a specimen which was not enveloped within an outer sclerinous layer ('cingulum' of Cookson and Dettmann 1958a, p. 100).

COMPARISON: The species differs from *Coptospora striata* sp. nov. and *C. reticulata* (Pocock) in its smaller size, scabrate exine, and larger hexagonal polar areas.

DISTRIBUTION: *C. paradoxa* shows wide lateral distribution in SE. Australia where it appears to have undoubted stratigraphical importance (see present study, Tables 5-7, 9; Cookson and Dettmann 1958b; Dettmann 1959). In the Ooodnadatta Bore, South Australia it is confined to the uppermost beds of the Roma (Aptian) Formation and to the Tambo (Albian) Formation; the specimens recorded by Cookson and Dettmann (1958b) from the Aptian sample (Cootabarlow Bore No. 2 at 1,354 ft) are, in fact, small, broken representatives of *Araucariacites australis* Cookson.

Coptospora sp. A

(Pl. XX, fig. 6-8)

DESCRIPTION: Microspores inaperturate or hilate, spheroidal; amb subcircular. Exine 6-7 μ thick; verrucate, except about one pole where it is radially fractured in a circular to elliptical area 50-60 μ in diameter; polar area composed of minute, radially arranged, discrete granules, and may be with an irregular rupture (hilum).

Closely-spaced, sometimes coalescent verrucae broadly rounded in optical section and with irregular to circular bases 3-8 μ in diameter. Inner surface of exine radially striated.

DIMENSIONS: Equatorial diameter (2 specimens) 81, 89 μ.

COMPARISON: The verrucate sculpture distinguishes this type from other species of *Coptospora*.

DISTRIBUTION: A rare type found in one sample from the Otway Basin, South Australia (see Table 5).

Coptospora sp. B

(Pl. XX, fig. 9, 10)

DESCRIPTION: Microspores inaperturate or hilate, spheroidal; amb subcircular. Exine 6 μ thick, radially fractured in a subcircular area (25 μ in diameter) about one pole; fractures delimit minute, radially elongated elements; polar area sometimes ruptured (hilate). Remainder of exine with widely-scattered, low (1-2 μ high) spinules and coni which have circular to irregular bases 1-2 μ in diameter. Inner surface of exine radially striated.

DIMENSIONS: Equatorial diameter (2 specimens) 79 μ, 89 μ; polar diameter (1 specimen) 48 μ.

COMPARISON: Distinct from *Coptospora striata* sp. nov., *C. reticulata* (Pocock), and *C.* sp. A in its spinulose sculpture.

DISTRIBUTION: Recovered from one sample in the Otway Basin, South Australia (see Table 4).

Genus **Cooksonites** Pocock emend.

1962 *Cooksonites* Pocock (pars), p. 54.

EMENDED DIAGNOSIS: Microspores tetrahedral, cingulate. Exine inaperturate or hilate; with structural and/or sculptural modification at and about the distal pole where a hilum may be formed as the result of a natural exinous breakdown. Sculptural/structural elements various. Enveloping outer layer of sclerine occasionally present, but not persistent.

TYPE SPECIES: *Cooksonites variabilis* Pocock 1962.

REMARKS AND COMPARISON: The above generic emendation is based upon the SE. Australian cingulate spores which conform with the type species and Pocock's Group I of the genus. In its cingulate feature *Cooksonites* Pocock is distinct from the acingulate spores which Pocock (1962) assigned to his Group II of the genus, and which are here allocated to *Coptospora* gen. nov. *Cooksonites* differs from *Aequitriradites* Delcourt & Sprumont which is characterized by an equatorially tapering, membraneous zona.

As noted previously the polar features of *Cooksonites, Coptospora,* and *Aequitriradites* are comparable to those of certain modern spores found in the Hepaticae.

Cooksonites variabilis Pocock 1962

(Pl. XXI, fig. 8-11)

DESCRIPTION: Microspores inaperturate or hilate, cingulate, spheroidal; amb subcircular to irregular. Exine rarely enveloped within a delicate outer sclerinous layer, and composed of one, structured, cingulate layer; cingulum 7-18 μ wide, smooth to irregular in outline. Proximal exine 3-5 μ thick, almost smooth, inaperturate, and rarely with faint tetrad mark. Distal exine 5 μ thick, patterned at and about the pole where it is radially and tangentially fractured. Fractures narrow; delimit discrete, radially arranged, areas which are subcircular to hexagonal in outline and 3-5 μ in diameter. Sometimes a distinct opening (hilum) with an irregular to circular outline is formed by the partial or complete breakdown of the distal polar exine.

DIMENSIONS: Equatorial diameter; overall 59 (75) 100 μ, spore cavity 45 (56) 75 μ. Polar diameter (7 specimens) 36 (45) 56 μ.

REMARKS: The preservation of the Australian specimens is variable, and their cingula show considerable variation in width, thickness, and outline. Complete sections were difficult to obtain as the exine fractured during cutting and mounting processes. The illustrated section (Pl. XXI, fig. 11) shows that the one-layered exine is thickened equatorially.

DISTRIBUTION: Pocock (1962) described the species from Valanginian-Barremian strata of Canada. In SE. Australia it shows widespread lateral distribution, and appears to be of some stratigraphical significance (see Tables 4, 6-9).

Genus **Aequitriradites** Delcourt & Sprumont emend. Cookson & Dettmann 1961

1955 *Aequitriradites* Delcourt & Sprumont, p. 44.
1961 *Selaginellidites* Krasnova in Samoilovitch et al., p. 38.
1961 *Aequitriradites* Delcourt & Sprumont emend. Cookson & Dettmann, p. 426.

TYPE SPECIES: *Aequitriradies dubius* Delcourt & Sprumont emend. Delcourt, Dettmann, & Hughes 1963.

OTHER SPECIES:

(1) *Aequitriradites verrucosus* (Cookson & Dettmann) Cookson & Dettmann 1961.
(2) *Aequitriradites tilchaensis* (Cookson & Dettmann) Cookson & Dettmann 1961.
(3) *Aequitriradites spinulosus* (Cookson & Dettmann) Cookson & Dettmann 1961.
(4) *Aequitriradites* (al. *Zonalasporites*) *acusus* (Balme 1957, p. 27; Pl. 5, fig. 64, 65; Pl. 6, fig. 66) comb. nov. Occurrence: Western Australia; Neocomian-Aptian.
(5) *Aequitriradites* (al. *Cirratriradites*) *luminosus* (Chlonova 1961, p. 53; Pl. 5, fig. 34) comb. nov. Occurrence: Siberia; Maastrichtian-Danian.
(6) *Aequitriradites variabilis* Pocock 1962. Occurrence: Canada; Barremian.
(7) *Aequitriradites* sp. A new type subsequently described herein.

The following species require further study for reliable identification with *Aequitriradites*:

(1) *Euryzonotriletes* sp. Sah 1953, p. 6; Pl. 1, fig. 19.
(2) *Aequitriradites salebrosaceus* (Maljavikina 1949, p. 65; Pl. 13, fig. 14) Nilsson 1958, p. 47; Pl. 3, fig. 8.
(3) *Aequitriradites* sp. A. Nilsson 1958, p. 47; Pl. 3, fig. 9.
(4) *Cirratriradites interruptus* Bolkhovitina 1959, p. 128; Pl. 8, fig. 117.
(5) *Selaginellidites densituberculatus* Krasnova in Samoilovitch et al. 1961, p. 39; Pl. 8, fig. 2.

The following specimens are distinct from *Aequitriradites*:

(1) *Aequitriradites infrapunctatus* Lantz 1958a, p. 36; Pl. 1, fig. 20; 1958b, p. 924; Pl. 3, fig. 31.
(2) *Aequitriradites* cf. *dubius* Delcourt & Sprumont: Lantz 1958b, p. 924; Pl. 1, fig. 30.

DISCUSSION: Subsequent to Cookson and Dettmann's (1961) reappraisal of the genus, Delcourt et al. (1963) demonstrated that the type species, *Aequitriradites* *dubius* Delcourt & Sprumont, is conspecific with *A. inconspicuous* Delcourt & Sprumont. Moreover, it is clear that the type species incorporates proximally inaperturate, zonate microspores which are characterized by either 'an opening' (hilum) 'in or modification of sculpture' and/or structure 'of the exine at and around the distal pole' (Cookson and Dettmann 1961, p. 425; see also Delcourt et al. 1963). Identical structural and morphological features are diagnosed for *Selaginellidites* Krasnova, and there is no doubt concerning the synonymy of this genus and *Aequitriradites* Delcourt & Sprumont.

COMPARISON: In possessing a membraneous zona *Aequitriradies* is readily distinguishable from *Cooksonites* Pocock and *Coptospora* gen. nov. *Kraeuselisporites* Leschik is proximally aperturate (trilete) and has membraneous, laesurate lips.

AFFINITY: The distal features of *Aequitriradites* resemble those of some modern hepatic spores (e.g., those of the Sphaerocarpaceae). Krasnova (in Samoilovitch et al. 1961) suggests that the genus has an affinity with *Selaginella* Spring the microspores of which, however, are clearly trilete (see Knox 1950, Selling 1946).

Aequitriradites verrucosus (Cookson & Dettmann) Cookson & Dettmann 1961

(Pl. XXII, fig. 1-5; Fig. 6b)

1958 *Cirratriradites verrucosus* Cookson & Dettmann, p. 112; Pl. 18, fig. 2-6.

1961 *Selaginellidites verrucosus* (Cookson & Dettmann) Krasnova in Samoilovitch et al. p. 40; Pl. 9, fig. 2, 3 (? fig. 1); Pl. 10, fig. 2-4; Pl. 11, fig. 1.

1961 *Aequitriradites verrucosus* (Cookson & Dettmann) Cookson & Dettmann, p. 427; Pl. 52, fig. 1-6.

DESCRIPTION: Microspores zonate, inaperturate or hilate, biconvex; and subcircular. Exine 2-3·5 μ thick, finely granulate except about the distal pole where it is radially and tangentially fractured in a circular area 14-25 μ in diameter. Distal polar area composed of radially arranged, discrete, low 'verrucate' elements which have hexagonal bases (1·5-3 μ in diameter) and pointed apices; sometimes an irregular to circular opening (hilum) is formed by the breakdown of the exine in this area. Proximal exine inaperturate and usually with a tetrad mark which constitutes narrow (1-2 μ wide), low, usually discontinuous ridges extending from the equator to terminate at varying distances from the pole. Zona membraneous, scabrate, 8-14 μ wide; with a smooth to serrate margin and a small, internal cavity near its inner margin.

DIMENSIONS: Equatorial diameter; overall 56 (71) 89 μ, spore cavity 34 (50) 62 μ.

REMARKS AND COMPARISON: Transverse sections (Pl. XXII, fig. 4, 5; Fig. 6b) show that the distal polar 'verrucate' elements are separated from each other by narrow interstices. The zona, which tapers gradually equatorially, is cavate near its inner margin.

The species is similar to *Aequitriradites dubius* Delcourt & Sprunmont, but differs in its finer overall sculpture, consistently narrower zona, and absence of interradially situated, radially orientated ridges on the zona.

DISTRIBUTION: Widely distributed in E. Australia (Cookson & Dettmann 1958a; present study, Tables 3-9). In U.S.S.R. it is known from Neocomian-Senonian strata (Bolkhovitina 1959; Chlonova 1961; Samoilovitch et al. 1961).

Aequitriradites spinulosus (Cookson & Dettmann)
Cookson & Dettmann 1961
(Pl. XXII, fig. 7-13; Fig. 6a)

1958 *Cirratriradites spinulosus* Cookson & Dettmann, p. 113; Pl. 18, fig. 9-13; Pl. 19, fig. 1, 2, 5-7 (non fig. 3, 4).
1961 *Selaginellidites spinulosus* (Cookson & Dettmann) Krasnova in Samoilovitch et al., p. 41; Pl. 11, fig. 2, 3.
1961 *Selaginellidites spinulosus* (Cookson & Dettmann) var. *hebatus* Krasnova in Samoilovitch et al., p. 42; Pl. 11, fig. 4; Pl. 12, fig. 1-4.
1961 *Selaginellidites spinulosus* (Cookson & Dettmann) var. *planus* Krasnova in Samoilovitch et al., p. 43; Pl. 12, fig. 6.
1961 *Aequitriradites spinulosus* (Cookson & Dettmann) Cookson & Dettmann, p. 427; Pl. 52, fig. 7-12.

DIAGNOSIS: As given by Cookson and Dettmann (1958b, p. 113). The term 'fovea' was used by these authors to describe the opening (hilum) in the distal polar exine. In inaperturate specimens, and as seen in transverse sections, the distal polar exine is composed of small, discrete, spinulose elements that are separated from one another by narrow fractures (Pl. XXII, fig. 10-13; Fig. 6a). The sections show also that the membraneous zona tapers equatorially, and that it is cavate near its inner limit.

FIG. 6—Drawings from photographs; all magnifications × 500. (a) *Aequitriradites spinulosus* (Cookson & Dettmann); section showing one-layered exine, cavate zona, and discrete distal spinules (see also Pl. XXII, fig. 12); Cootabarlow Bore No. 2 at 1,376-77 ft, D289/S65d/1-2 44·1 111·6 (P22134); (b) *Aequitriradites verrucosus* (Cookson & Dettmann); section showing one-layered exine, cavate zona, and discrete distal 'verrucae' (see also Pl. XXII, fig. 4); Cootabarlow Bore No. 2 at 1,376-77 ft, D289/S67/3 30·5 119·2 (P22132); (c) *Couperisporites tabulatus* sp. nov.; section showing two-layered sclerine, the outer layer of which is zonate, and hollow proximal verrucae (see also Pl. XXI, fig. 18, 19); Cootabarlow Bore No. 2 at 1,376-77 ft, D289/S64/1 30·3 116·2 (P22130); (d) *Rouseisporites reticulatus* Pocock; section showing two-layered sclerine, the outer layer of which forms the zona and the distal muroid ridges (see also Pl. XXIII, fig. 8); Cootabarlow Bore No. 2 at 1,376-77 ft, D289/S68/2 30·5 126·4 (P22139); (e) *Tsugaepollenites trilobatus* (Balme); section showing equatorially monosaccate, two-layered exine which encloses small vesiculae in the polar regions (see also Pl. XXIV, fig. 9); Cootabarlow Bore No. 2 at 1,469-70 ft, D302/S76b/1-2 23·6 112·6 (P22146); (f) *Tsugaepollenites* cf. *T. segmentatus* (Balme); section showing equatorially monosaccate, two-layered exine which encloses small vesiculae in the polar regions (see also Pl. XXIV, fig. 16); Cootabarlow Bore No. 2 at 1,469-70 ft, D302/S76a/1-2 39·1 116·1 (P22150).

DIMENSIONS: Equatorial diameter; overall 45 (65) 86 μ, spore cavity 34 (47) 65 μ. Polar diameter (2 specimens) 34 μ, 48 μ. Width of zona 5-14 μ; diameter of distal polar area 14-28 μ.

REMARKS: *Aequitriradites spinulosus*, as eircumseribed by Cookson and Dettmann (1958b), is a broad type, and neither these authors nor the present writer have found any satisfactory criterion which may be used to subdivide the species into more restricted taxonomie units. Krasnova (in Samoilovitch et al. 1961) has proposed three varieties of the species—var. *spinulosus* (presumably, as it includes the holotype of the speeies), var. *hebatus*, and var. *planus*—but she has not demonstrated conclusively or defined the distinguishing characters of her three varieties.

It should be noted that of the spores illustrated on Plate 19 of Cookson and Dettmann's publication (1958b), only those depicted in fig. 1, 2, 5, 6, and 7 are representatives of *A. spinulosus*; specimens depicted in fig. 6 and 7 were incorrectly eaptioned (as *Styxisporites linearis* Cookson & Dettmann) in the aceompanying plate explanation, and the one shown in fig. 6 is refigured by Potonié (1960; Pl. 4, fig. 69) under the same generic name. The specimen shown in fig. 3 and 4 is the holotype *Kraeuselisporites* (al. *Styxisporites*) *linearis* (see Cookson and Dettmann 1959d; present study, discussion of *K. linearis*).

COMPARISON: *A. spinulosus* is distinct from *A. variabilis* Pocock in its narrower zona and in having proximal sculpture; and from *A. acusus* (Balme) in having larger sculptural elements.

DISTRIBUTION: The species is widely distributed in E. Australia, but it has not been observed in samples from the lowest horizons of the Upper Mesozoie sequenee in the Great Artesian Basin (see Cookson and Dettmann 1958b; Dettmann 1959; present study, Tables 4-9). Extra-Australian oceurrences inelude Hauterivian-Danian of U.S.S.R. (Bolkhovitina 1959; Samoilovitch et al. 1961) and Valanginian-Barremian of Canada (Poeock 1962).

Aequitriradites tilchaensis (Cookson & Dettmann)
Cookson & Dettmann 1961
(Pl. XXIII, fig. 1-3)

1958 *Cirratriradites tilchaensis* Cookson & Dettmann, p. 113; Pl. 18, fig. 7, 8.
1961 *Aequitriradites tilchaensis* (Cookson & Dettmann) Cookson & Dettmann, p. 427.

DIAGNOSIS: As given by Cookson and Dettmann (1958b, p. 113). The 'laesurae of the tetrad-sear' are the narrow, sometimes diseonnected ridges of the tetrad mark, and the distal 'fovea' is the rupture (hilum) whieh may be developed in the polar, verrueate area.

DIMENSIONS: (8 speeimens) Equatorial diameter; overall 42 (50) 58 μ, spore eavity 34 (40) 47 μ. Width of zona 3-7 μ; diameter of distal polar verrucate area 14-17 μ.

REMARKS AND COMPARISON: Proximal and distal foei of the holotype are depicted in Pl. XXIII, fig. 1, 2. *Aequitriradites tilchaensis* (Cookson & Dettmann) differs from *A. verrucosus* (Cookson & Dettmann) and *A. dubius* Delcourt & Sprumont in its almost smooth proximal and equatorial exine, narrower zona, and smaller size.

DISTRIBUTION: Of rare oeeurrenee in the Great Artesian and Otway Basins, South Australia (see Tables 4, 5, 7, 9). It has been recorded also from Albian strata of Queensland and New South Wales (Cookson and Dettmann 1958b).

Aequitriradites sp.

(Pl. XXII, fig. 14, 15)

Description: Microspores zonate, inaperturate or hilate; amb of spore cavity triangular with straight sides. Exine 2·5-3 μ thick; distal polar exine composed of discrete, polygonal-based (2-3 μ diameter), low (2 μ high) coni and may be ruptured (hilate); remainder of exine sculptured with small (1 μ basal diameter, 1-2 μ high), sparsely disposed spinules. Zona membraneous, 14-17 μ wide, irregular in outline. Tetrad mark occasionally present in form of narrow, low ridges which extend from equator to just beyond inner margin of zona.

Dimensions: (5 specimens) Equatorial diameter; overall 77 (86) 100 μ, spore cavity 64 (69) 78 μ. Diameter of distal polar area 13-15 μ.

Comparison: The five specimens referred to *Aequitriradites* sp. are distinct from *A. spinulosus* (Cookson & Dettmann) and *A. variabilis* Pocock in their distinctly triangular amb (of spore cavity), larger size, and more sparsely distributed spinules. Insufficient representatives have been obtained for the institution of a formally named species.

Distribution: Recovered from one sample only of the Blythesdale Group in the Great Artesian Basin, South Australia (see Table 8).

Genus **Couperisporites** Pocock 1962

Type Species: *Couperisporites complexus* (Couper) Pocock 1962.

Couperisporites tabulatus sp. nov.

(Pl. XXI, fig. 12-19; Fig. 6c)

Diagnosis: Microspores inperturate or hilate, biconvex; amb roundly triangular to subcircular. Sclerine two-layered; consisting of a thin (1-2 μ thick), inner layer and an enveloping, 'zonate', outer layer. Outer layer 2-3 μ thick, scabrate; polar areas composed of hexagonal-based verrucae individually separated by narrow, deep channels. Proximal verrucate elements hollow, 2-5 μ in basal diameter, and *c.* 2 μ high; distal verrucae considerably lower (less than 1 μ high). Proximal surface occasionally with an irregular rupture (hilum) at and about the pole. Equatorial 'zona' 5-7 μ wide. Tetrad mark comprises three, low, narrow, radial ridges which extend from equator towards proximal pole. Inner layer bears impression of polar verrucae and tetrad mark.

Dimensions: (21 specimens) Equatorial diameter; overall 48 (64) 83 μ, spore cavity 42 (52) 67 μ.

Holotype: Preparation D289/2 53·1 119·9 P21985; Pl. XXI, fig. 12, 13. Distal aspect. Amb subtriangular, 76 μ in diameter. Sclerine 3 μ thick; 'zona' 6 μ wide. Proximal sclerine with hollow verrucae 2-5 μ in basal diameter. Tetrad mark consists of three, low, narrow, radial ridges 10 μ in length.

Locus Typicus: South Australia, Cootabarlow Bore No. 2 at 1,376-77 ft.

Remarks and Comparison: Transverse sections (Pl. XXI, fig. 17-19; Fig. 6c) show the stratified nature of the sclerine which is sometimes hilate proximally. *Couperisporites complexus* (Couper) possesses a two-layered, zonate, sclerine which may be hilate (see Pocock 1962; Pl. 6, fig. 91), but Couper's species differs from *C. tabulatus* sp. nov. in having spinose elements distally. *C. tabulatus* is distinct from *Selaginella elegans* Krasnova in having hexagonal-based verrucae which are restricted to the polar regions.

AFFINITY: The species shows some resemblance to the spores, which are hilate proximally, of the fossil *Naiadita lanceolata* Buchman (see Harris, T. M. 1938, Fig. 21, 22; present study, Appendix I; Pl. XXVII, fig. 9-11).

DISTRIBUTION: Recovered from a few samples of the Great Artesian Basin (see Tables 4, 6).

Genus **Rouseisporites** Pocock 1962

RESTATED DIAGNOSIS: Microspores inaperturate proximally; amb convexly triangular to circular. Sclerine two-layered; outer layer membraneous, sometimes loosely enveloping, zonate. Zona with a flask-shaped to conical invagination in each radial region. Distal surface with muroid ridges which may anastomose to form a reticulum; proximal surface smooth to reticulate. Tetrad mark which comprises three, radial ridges distinct or faintly represented.

TYPE SPECIES: *Rouseisporites reticulatus* Pocock 1962.

OTHER SPECIES:

(1) *Rouseisporites laevigatus* Pocock 1962. Occurrence: Canada; Barremian.
(2) *Rouseisporites triangularis* Pocock 1962. Occurrence: Canada; Barremian-Lower Aptian.
(3) *Rouseisporitese granospeciosus* (Delcourt & Sprumont) Delcourt, Dettmann, & Hughes 1963. Occurrence: Belgium; Wealden.
(4) *Rouseisporites* (al. *Cingulatisporites*) *simplex* (Cookson & Dettmann 1958, p. 110; Pl. 17, fig. 7, 8) comb. nov.
(5) *Rouseisporites radiatus* sp. nov.

The following forms may be comparable to *Rouseisporites*:

(1) *Divisisporites euskirchenensis* Thomson 1952. Potonié (1956) incorrectly cites this species as the type of *Divisisporites* Pflug.
(2) *Hymenozonotriletes bracteatus* Bolkhovitina 1959.
(3) *Hymenophyllum* aff. *australea* Willd.: Verbitskaya 1962.

REMARKS AND COMPARISON: Pocock (1962) fully recognized that the genus is characterized by a two-layered sclerine, the outer, zonate layer of which has invaginations in each radial region at the equator. *Rouseisporites* Pocock is further characterized by a proximally inaperturate sclerine and hollow muroid ridges distally (see Fig. 6d). The distal muroid ridges of several species now included within the genus were described erroneously by Delcourt and Sprumont (1955) and Cookson and Dettmann (1958b) as proximal laesurae.

At noted by Delcourt et al. (1963) *Rouseisporites* is distinct from *Zlivisporis* Paeltova and *Seductisporites* Chlonova in possessing invaginations in each equatorial, radial region.

AFFINITY: The genus is morphologically comparable to some of the spores found in the Ricciaceae and Clevaceae. In particular, the type species, *R. reticulatus* Pocock, closely resembles the spores of the living *Riccia beyrichiana* Hampe and *R. canaliculata* Hoffm. These modern hepatic spores possess an outer, zonate membrane which has invaginations in the equatorial, radial regions and hollow, muroid ridges distally (see Erdtman 1957, Fig. 241; Ladyzhenskaja 1961, Fig. 1). The distal ridges are considered to serve as potential apertures during spore germination, and it has been demonstrated conclusively that the spores of *Riccia* (Mich.) germinate distally (Duthie and Garside 1936, Udar 1957).

Rouseisporites reticulatus Pocock 1962
(Pl. XXIII, fig. 4-9; Fig. 6d)

1958 *Cingulatisporites euskirchensoides* Delcourt & Sprumont: Cookson & Dettmann (pars), p. 109; Pl. 17, fig. 5.
1962 *Rouseisporites reticulatus* Pocock, p. 53; Pl. 7, fig. 101-105.

DESCRIPTION: Microspores biconvex; amb subcircular to convexly triangular. Sclerine two-layered; consisting of a scabrate, inner layer, 1-1·5 μ thick, and an enveloping, membraneous, zonate, outer layer which is reticulate both distally and proximally. Zona membraneous, 3-6 μ wide, and with a flask-shaped invagination in each radial region at equator. Distal reticulum composed of membraneous, muroid ridges (2-3 μ high) which enclose hexagonal lumina 15-30 μ in maximum diameter; ridges higher and wider about the pole. Proximal reticulum smaller meshed; with low, narrow muri and circular to polygonal lumina 1-4 μ in maximum diameter. Faint tetrad mark comprising three, low, radial ridges, which terminate near the invaginations, is usually developed on the proximal surface.

DIMENSIONS: Equatorial diameter; overall 45 (61) 78 μ, spore cavity 39 (53) 67 μ.

REMARKS: Transverse sections confirm that the membraneous outer wall layer forms the zona and the surface reticula. The muroid ridges of the distal reticulum are hollow, and this feature is depicted both in section (Pl. XXIII, fig. 8, 9; Fig. 6d) and surface view (Pl. XXIII, fig. 5-7).

COMPARISON: The following specimens resemble *Rouseisporites reticulatus* Pocock, but none of them clearly show invaginations in the equatorial, radial regions:

(1) *Divisisporites euskirchenensis* Thomson (Thomson and Pflug 1952, p. 14; Pl. 1, fig. 6 (holotype): Chlonova 1961, p. 51; Pl. 5, fig. 32).
(2) *Hymenozonotriletes bracteatus* Bolkhovitina (Bolkhovitina 1959, p. 106; Pl. 4, fig. 65a, c: Chlonova 1961, p. 52; Pl. 5, fig. 33).

The species is readily distinguishable from *R. granospeciosus* (Delcourt & Sprumont) and *Seductisporites signifer* Chlonova in having a reticulate proximal surface together with a coarse-meshed, distal reticulum.

AFFINITY: The spores of *Riccia beyrichiana* Hampe are similar in overall construction to *Rouseisporites reticulatus*.

DISTRIBUTION: Pocock (1962) described the species from Barremian-Lower Albian strata of Canada, and Samoilovitch et al. (1961; Pl. XXVIII, fig. 15, Pl. XLII, fig. 9, 10) depict comparable specimens from Aptian-Albian and Turonian beds of Siberia. The species is widely distributed in E. Australia (Cookson and Dettmann 1958b; Dettmann 1959; present study, Tables 4-9); in the Great Artesian Basin it occurs in the upper horizons of the Blythesdale Group, throughout the Roma (Aptian) and Tambo (Albian) Formations, and in samples examined from the Winton Formation (?Cenomanian).

Rouseisporites simplex (Cookson & Dettmann) comb. nov.
(Pl. XXIII, fig. 10-12)

1958 *Cingulatisporites simplex* Cookson & Dettmann, p. 110; Pl. 17, fig. 7, 8.

DESCRIPTION: Microspores biconvex; amb convexly subtriangular to subcircular. Sclerine two-layered; inner layer 1·5-2·5 μ thick, scabrate. Membraneous outer layer forms a narrow (2-5 μ wide), delicate zona (which invaginates a flask-shaped depression in each radial region at equator) and three, radially orientated, muroid ridges distally. Distal muroid ridges 2-3 μ high; emanating from pole and extending to equator along bisectors of interradial surfaces. Proximal surface smooth or with a faint tetrad mark, the inconspicuous ridges of which terminate near the equatorial invaginations.

DIMENSIONS: Equatorial diameter; overall 42 (57) 77 μ, spore cavity 36 (51) 67 μ.

COMPARISON: *Rouseisporites simplex* (Cookson & Dettmann) resembles *R. triangularis* Pocock and two of the illustrated specimens of *Hymenozonotriletes bracteatus* Bolkhovitina (1959; Pl. 4, fig. 65d, e). However, the Australian species is readily distinguishable from both these forms in having a less conspicuous tetrad mark, shorter distal muroid ridges, and a more delicate outer layer which invaginates smaller depressions in the equatorial, radial regions. Both *R. laevigatus* Pocock and *R. granospeciosus* (Delcourt & Sprumont) differ from *R. simplex* in having more than three distal muroid ridges which usually bifurcate towards the equator. *R. reticulatus* Pocock has a reticulate surface pattern both proximally and distally.

DISTRIBUTION: The species shows wide lateral, and restricted vertical, distribution in the Upper Mesozoic of SE. Australia (Cookson and Dettmann 1958b; Dettmann 1959; present study, Tables 4-9); in the Oodnadatta bore it appears to be restricted to the Roma (Aptian) and Tambo (Albian) Formations.

Rouseisporites radiatus sp. nov.
(Pl. XXIII, fig. 13-17)

1958 *Divisisporites euskirchenensis* Thomson: Cookson & Dettmann, p. 98; Pl. 14, fig. 1.
1958 *Cingulatisporites euskirchensoides* Delcourt & Sprumont: Cookson & Dettmann (pars), p. 109; Pl. 17, fig. 4, 6.

DIAGNOSIS: Microspores biconvex; amb subcircular to convexly subtriangular. Sclerine two-layered; inner layer 2-2·5 μ thick, faintly scabrate. Enveloping outer layer membraneous, zonate; smooth proximally and with four to six, radially disposed, muroid ridges distally. Muroid ridges emanate from pole and bifurcate towards equator where they are reduced in height. Narrow zona with a conical invagination (2-3 μ in diameter) in each radial region at equator.

DIMENSIONS: Equatorial diameter; overall 42 (56) 73 μ, spore cavity 39 (50) 64 μ.

HOLOTYPE: Preparation D272/2 43·2 127·6 P22140; Pl. XXIII, fig. 15, 16. Proximal aspect. Amb convexly subtriangular, 73 μ in diameter. Membraneous outer layer zonate; with an invagination (*c.* 3 μ in diameter) in each radial region at equator and four, radially orientated, muroid ridges (up to 28 μ long) distally. Inner layer faintly scabrate, 2·5 μ thick.

LOCUS TYPICUS: South Australia, Penola Bore No. 1 at 2,380-90 ft.

REMARKS AND COMPARISON: The membraneous outer wall layer of this species is often imperfectly preserved, particularly in the equatorial regions. The species may be comparable to *Seductisporites signifer* Chlonova and the spores which Verbitskaya (1962) assigned to *Hymenophylllum* aff. *australea* Willd., but neither Russian form appears to possess conical invaginations in the radial regions at the equator. *Rouseisporites radiatus* sp. nov. is distinct from *R. granospeciousus* (Delcourt & Sprumont) which has a wider zona, thicker outer wall layer, and a more heavily sculptured inner wall layer; *R. laevigatus* Pocock has more muroid ridges which are considerably lower, and both *R. simplex* (Cookson & Dettmann) and *R. triangularis* Pocock have three only, muroid ridges.

DISTRIBUTION: The species is of common occurrence in certain horizons of the Great Artesian and Otway Basins (see Tables 4-7, 9).

ANTETURMA POLLENITES Potonié 1931

TURMA SACCITES Erdtman 1947

Subturma MONOSACCITES Chitaley emend. Potonié & Kremp 1954

Infraturma SACCIZONATI Bhardwaj 1957

Genus **Tsugaepollenites** Potonié & Venitz emend. Potonié 1958

1934 *Tsugaepollenites* Potonié & Venitz, p. 17.
1937 *Tsugaepollenites* Raatz, p. 15.
1953 *Zonalapollenites* Pflug (nom. nud.) in Thomson & Pflug, p. 66.
1958 *Tsugaepollenites* Potonié & Venitz emend. Potonié, p. 48.
1958 *Cerebropollenites* Nilsson, p. 72.
1961 *Callialasporites* Dev, p. 48.
1961 *Applanopsis* Döring, p. 112.
1961 *Triangulopsis* Döring, p. 113.
1962 *Pflugipollenites* Pocock, p. 72.

RESTATED DIAGNOSIS: Pollen grains monoscaccate equatorially, inaperturate; proximal tetrad mark which comprises three, radial ridges distinct or only faintly represented. Exine smooth to granulate, two-layered; exoexine and intexine attached about the polar regions, but separated from each other at the equator where they enclose one, encircling saccus or several, intercommunicating vesiculae. Exine of polar regions sometimes with considerably reduced vesiculae; distal polar exine usually slightly thinner than proximal polar exine.

TYPE SPECIES: *Tsugaepollenites igniculus* (Potonié) Potonié & Venitz 1934.

MESOZOIC SPECIES NOT PREVIOUSLY INCLUDED WITHIN TSUGAEPOLLENITES:

(1) *Tsugaepollenites* (al. *Zonalapollenites*) *dampieri* (Balme) comb. nov.
(2) *Tsugaepollenites* (al. *Zonalapollenites*) *segmentatus* (Balme) comb. nov.
(3) *Tsugaepollenites* (al. *Zonalapollenites*) *trilobatus* (Balme) comb. nov.
(4) *Tsugaepollenites* (al. *Callialasporites*) *monoalosporus* (Dev 1961, p. 48; Pl. 14, fig. 25) comb. nov. Occurrence: India; ? Aptian (after Arkell 1956).
(5) *Tsugaepollenites* (al. cf. *Callialasporites*) sp. Dev 1961, p. 49; Pl. 4, fig. 30, 31. Occurrence: India; ? Aptian (after Arkell 1956).
(6) *Tsugaepollenites* (al. *Applanopsis*) *lenticularis* (Döring 1961, p. 113; Pl. 16, fig. 9, 10) comb. nov. Occurrence: Germany; Upper Jurassic.
(7) *Tsugaepollenites* (al. *Triangulopsis*) *discoidalis* (Döring 1961, p. 114; Pl. 17, fig. 1-3) comb. nov. Occurrence: Germany; Upper Jurassic.
(8) *Tsugaepollenites* (al. *Pflugipollenites*) *lucidus* (Pocock 1962, p. 72; Pl. 12, fig. 185) comb. nov. Occurrence: Canada; Upper Jurassic.
(9) *Tsugaepollenites* (al. *Noeggerathiopsidozonaletes*) *undatus* (Lantz 1958b, p. 925; Pl. 4, fig. 43-45) comb. nov. Occurrence; Britain; Bathonian-Kimeridgian.
(10) *Tsugaepollenites* (al. *Aequitriradites*) *infrapunctatus* (Lantz 1958a, p. 36; Pl. 1, fig. 20) comb. nov. Occurrence: France; Purbeckian: Britain; Bathonian (after Lantz 1958b).
(11) *Tsugaepollenites* (al. *Cingulatisporites*) *dubius* (Couper 1958, p. 145; Pl. 24, fig. 3-5) comb. nov. Occurrence: Britain; Bajocian-Kimeridgian.
(12) *Tsugaepollenites* (al. *Inaperturopollenites*) *undulatus* (Weyland & Greifeld 1953, p. 44; Pl. 13, fig. 89, 90) comb. nov. Occurrence: Germany; Lower Senonian.

DISCUSSION AND COMPARISON: Potonié's (1931, 1958) and Potonié and Venitz's (1934) illustrations and descriptions of the type species indicate that the genus is characterized by a two-layered exine which is monosaccate equatorially and which encloses small vesiculae ('muri to warts' of Potonié 1958; see also Manum 1962, p. 45) in the polar region. Comparable morphological features are exhibited by the more recently established genera that are cited in the synonymy above.

The equatorial saccus of *Tsugaepollenites* Potonié & Venitz may be ± uniform in width (as in *T. dampieri*), or constricted at the equator and composed of several (for example, in *T. trilobatus*) to many (*T. mesozoicus* Couper), intercommunicating vesiculate protrusions. Small polar vesiculae are exhibited by some species included within the genus, and the proximal exine (which usually is thicker and patterned more conspicuously than the distal exine) sometimes exhibits a tetrad mark.

The genus may be similar in construction to the imprecisely known genera, *Tsugella* Maljavikina, *Zonalasporites* Ibrahim, and *Enzonalasporites* Leschik.

AFFINITY: Potonié (1958) compares the type species with the pollen of *Tsuga* Carr., and both Couper (1958) and Balme (1957) suggest that their Mesozoic species are of coniferous origin. Döring (1961) claims that his forms, *Applanopsis* and *Triangulopsis*, probably have derived from planktonic organisms, but there is no evidence for this relationship.

Tsugaepollenites dampieri (Balme) comb. nov.

(Pl. XXIV, fig. 1-5)

SELECTED SYNONYMY:

1957 *Zonalapollenites dampieri* Balme, p. 32; Pl. 8, fig. 88, 90 (? fig. 89).
1961 *Callialasporites dampieri* (Balme) Dev, p. 48; Pl. 4, fig. 26, 27.
1961 *Applanopsis dampieri* (Balme) Döring, p. 113; Pl. 16, fig. 11-15.
1962 *Pflugipollenites dampieri* (Balme) Pocock, p. 72 (? Pl. 12, fig. 183, 184).

DESCRIPTION: Grains monosaccate, biconvex; amb subcircular, sometimes undulate. Exine two-layered; consisting of a thin (*c.* 1·5 μ thick) intexine which is completely enclosed within a thicker (1·5-2 μ), granulate exoexine. Intexine and exoexine closely adherent in polar regions, but enclose a narrow saccus equatorially; saccus radially folded, slightly constricted in each radial region at equator. Tetrad mark absent or only faintly represented.

DIMENSIONS: Equatorial diameter; overall 53 (67) 80 μ, intexine 40 (53) 68 μ.

COMPARISON: *Tsugaepollenites dampieri* (Balme) is distinguishable from *T. lucidus* (Pocock) in having a narrower saccus which is radially folded. *T. dubius* (Couper) possesses a more prominent tetrad mark and has a thicker exine.

DISTRIBUTION: *T. dampieri* is widely distributed in Australasian sediments, with documented occurrences from the Jurassic, Cretaceous, and Eocene of Western Australia (Balme 1957); Lower Jurassic of Queensland (de Jersey 1959); and Aptian-Albian of Papua (Balme 1957). In SE. Australia the species is of infrequent occurrence in the Upper Mesozoic of the Great Artesian Basin, and rare in samples examined from the Otway and Murray Basins and E. Victoria (see Tables 3-9). Numerous extra-Australasian records indicate that the species is represented in Upper Mesozoic strata of India, Canada, and Europe.

Tsugaepollenites trilobatus (Balme) comb. nov.

(Pl. XXIV, fig. 6-10; Fig. 6e)

SELECTED SYNONYMY:

1957 *Zonalapollenites trilobatus* Balme, p. 33; Pl. 8, fig. 91, 92.
1961 *Callialasporites trilobatus* (Balme) Dev, p. 48; Pl. 4, fig. 28, 29.
1961 *Triangulopsis trilobatus* (Balme) Döring, p. 114; Pl. 17, fig. 4-8.
1962 *Pflugipollenites trilobatus* (Balme) Pocock, p. 73; Pl. 12, fig. 186, 187.

DESCRIPTION: Grains saccate, biconvex. Amb subtriangular; convex interradially and indented radially. Exine two-layered; intexine 1·5-2 μ thick, smooth to faintly patterned, and with a convexly triangular amb. Exoexine 2·5-3 μ thick, granulate; loosely envelops intexine, particularly at the equator where a trilobate, usually radially folded saccus is developed. Polar areas of exoexine inconspicuously vesiculate; low (*c.* 1 μ high) vesiculae polygonal (1-3 μ in diameter) in basal outline; distal polar exoexine thinner than proximal polar exoexine. Tetrad mark inconspicuous; consists of three, low, weakly sinuous ridges (2 μ wide) which extend from pole to equator.

DIMENSIONS: Equatorial diameter; overall 67 (76) 86 μ, intexine 42 (53) 64 μ. Maximum width of saccus 12-17 μ.

REMARKS AND COMPARISON: Transverse sections (Pl. XXIV, fig. 9, 10; Fig. 6e) show that the grains are saccate equatorially, and that the exoexine encloses small vesiculae in the polar regions. The species is clearly distinguishable from *Tsugaepollenites discoidalis* (Döring) in having a trilobate, radially folded saccus and low polar vesiculae. *T. trilobatus* (Balme) differs from *T. dampieri* (Balme) and *T. segmentatus* (Balme), the entexines of which are distinctly circular in equatorial outline.

DISTRIBUTION: Apparently widespread in Upper Mesozoic strata, with previous records from Upper Jurassic and Lower Cretaceous of Britain (Lantz 1958b, Hughes and Couper 1958), Germany (Döring 1961), and Western Australia (Balme 1957); from Middle and Upper Jurassic of Canada (Pocock 1962), and from Lower Cretaceous of India (Dev 1961). The species is of sporadic occurrence in the Upper Mesozoic samples from SE. Australia (see Tables 3-8).

Tsugaepollenites cf. **T. segmentatus** (Balme) comb. nov.

(Pl. XXIV, fig. 11-16; Fig. 6f)

1957 *Zonalapollenites segmentatus* Balme, p. 33; Pl. 8, fig. 91, 92.

DESCRIPTION: Grains biconvex; saccate equatorially, vesiculate in polar regions. Amb subcircular to broadly elliptical, usually irregularly indented. Exine two-layered; thin (*c.* 1 μ thick) intexine completely enclosed within a thicker (2-3 μ thick), proximally and distally attached, granulate exoexine; distal polar exoexine thinner than proximal exoexine. Equatorial saccus 5-14 μ wide and usually with intense, radially directed folds; polar vesiculae low (*c.* 1-2 μ high), circular to elongated in basal outline. Tetrad mark comprises three, radially orientated, sinuous ridges (2 μ wide) which extend from pole to equator.

DIMENSIONS: Equatorial diameter; overall 50 (64) 78 μ, intexine 40 (49) 59 μ.

REMARKS AND COMPARISON: Transverse sections (Pl. XXIV, fig. 15, 16; Fig. 6f) show that the exine is vesiculate both proximally and distally and saccate equatorially. The SE. Australian specimens are similar to *Tsugaepollenites segmentatus* (Balme) except that they possess a tetrad mark and are larger in size. The species may be comparable to *T. lenticularis* (Döring) the illustrated holotype of which, however, has a thicker intexine. *T. segmentatus* is distinct from *T. dampieri* (Balme) in having polar vesiculae and a thicker exoexine which forms the more strongly folded and narrower equatorial saccus.

DISTRIBUTION: The species was described from Lower Jurassic strata, and doubtfully recorded in Upper Jurassic sediments of Western Australia (Balme 1957). It was recorded subsequently by de Jersey (1959) from Lower Jurassic coals of Queensland. The similar grains described above are of infrequent occurrence in samples from the Great Artesian and Otway Basins and E. Victoria (see Tables 3-8).

Subturma DISACCITES Cookson 1947

REMARKS: Four bisaccate species are recorded herein with little taxonomic comment. The dimensional terminology of Zauer (1954), Bolkhovitina (1956), and Pocock (1962) has been adopted (see Fig. 3).

It should be noted that the present writer has followed Pocock (1962) in using *Alisporites* Daugherty and *Podocarpidites* Cookson ex Couper which may or may not be comparable to *Pityosporites* Seward. The type specimen of the latter genus is preserved in equatorial aspect, and its distal polar features (including the nature, shape, and extent of the tenuitas or aperture) and the equatorial outline of the corpus and sacci are not precisely determinable. Manum (1960) recently redefined *Pityosporites*, and supported his generic emendation with new illustrations and descriptions of the type specimen; optical sections (loc. cit.; Pl. 1, fig. 1,2) of this specimen resemble polar sections of tenuate grains referred herein to *Podocarpidites* cf. *P. multesimus* (Bolkhovitina) (see Pl. XXV, fig. 16).

Genus **Alisporites** Daugherty 1941

TYPE SPECIES: *Alisporites opii* Daugherty 1941.

Alisporites grandis (Cookson) comb. nov.

(Pl. XXV, fig. 1-4)

SELECTED SYNONYMY:

1953 *Dissaccites grandis* Cookson, p. 471; Pl. 2, fig. 41.
1957 *Pityosporites grandis* (Cookson) Balme, p. 36; Pl. 10, fig. 110, 111.
1959 *Alisporites rotundus* Rouse, p. 316; Pl. 1, fig. 15, 16.

DIMENSIONS: Breadth; overall 78 (102) 136 μ, corpus 36 (53) 70 μ, saccus 31 (45) 62 μ. Length; corpus 56 (73) 97 μ, saccus 56 (71) 94 μ. Depth of corpus 39 (41) 45 μ.

REMARKS: In the light of Pocock's (1962) descriptions and illustrations there is now little doubt concerning the synonymy of *Alisporites rotundus* Rouse and *A. grandis* (Cookson).

DISTRIBUTION: The species is fairly common in almost all the samples examined (see Tables 3-9). It has been reported previously from the Upper Jurassic and Lower Cretaceous of Western Australia (Balme 1957) and Canada (Rouse 1959, Pocock 1962).

Alisporites similis (Balme) comb. nov.

(Pl. XXV, fig. 5-7)

1957 *Pityosporites similis* Balme, p. 36; Pl. 10, fig. 108, 109.

DIMENSIONS: Breadth; overall 45 (56) 67 μ, corpus 28 (34) 42 μ, saccus 17 (21) 25 μ. Length; corpus 31 (38) 45 μ, saccus 31 (38) 45 μ. Depth of corpus not determined.

DISTRIBUTION: The species occurs in the Upper Jurassic and Lower Cretaceous of Western Australia (Balme 1957), and shows wide distribution in SE. Australia (see Tables 3-9); it has not been observed in any samples examined from the Winton Formation (?Cenomanian) in the Great Artesian Basin.

Genus **Podocarpidites** Cookson ex Couper 1953

TYPE SPECIES: *Podocarpidites ellipticus* Cookson 1947.

Podocarpidites cf. **P. ellipticus** Cookson 1947

(Pl. XXV, fig. 8-12)

DIMENSIONS: Breadth; overall 50 (59) 75 μ, corpus 31 (38) 45 μ, saccus 17 (22) 28 μ. Length; corpus 28 (36) 50 μ, saccus 28 (37) 45 μ. Depth of corpus 25 (30) 38 μ.

REMARKS: Sections of a representative grain are shown on Pl. XXV, fig. 11, 12; these were cut parallel to the polar axis and obliquely both to the greatest breadth and the distal tenuitas of the grain.

DISTRIBUTION: Grains similar to Cookson's Kerguelen species, *Podocarpidites ellipticus*, are reported as usually abundant in Jurassic and Lower Cretaceous strata of Western Australia (Balme 1957), and are common in the Upper Mesozoic of SE. Australia (see Tables 3-9).

Podocarpidites cf. **P. multesimus** (Bolkhovitina) Pocock 1962

(Pl. XXV, fig. 13-16)

DIMENSIONS: Breadth; overall 64 (82) 117 μ, corpus 36 (46) 62 μ, saccus 28 (39) 59 μ. Length; corpus 30 (45) 67 μ, saccus 45 (60) 83 μ. Depth of corpus 28 (31) 36 μ.

REMARKS: The SE. Australian grains are similar to those described by Pocock (1962) but show a considerably greater size range. A section which has been cut parallel to both the polar axis and the greatest breadth of the grain is shown in Pl. XXV, fig. 16.

DISTRIBUTION: The species is known from the Lower Cretaceous of Russia (Bolkhovitina 1956), and from Lower and Upper Cretaceous strata of Canada (Rouse 1957, Pocock 1962). The similar grains recorded herein are of infrequent occurrence in the Upper Mesozoic of SE. Australia (see Tables 3-9).

Subturma POLYSACCITES Cookson 1947

Genus **Microcachyridites** Cookson ex Couper 1953

TYPE SPECIES: *Microcachyridites antarcticus* Cookson 1947.

Microcachyridites antarcticus Cookson 1947

(Pl. XXVI, fig. 1-5)

DIMENSIONS: Breadth; overall 28 (44) 56 μ, corpus 26 (37) 45 μ, saccus 11 (15) 20 μ. Length; corpus 26 (37) 45 μ, saccus 14 (24) 28 μ. Depth of corpus 20 (25) 31 μ.

REMARKS: Sections cut parallel to the polar axis of a grain are shown on Pl. XXVI, fig. 4, 5.

DISTRIBUTION: A widely distributed species in Australasian strata. Couper (1953, 1960) records it as ranging from Lower Cretaceous to Oligocene in New Zealand, and in Western Australia it ranges from Middle Bajocian to Eocene. In E. Australia the species is common in Upper Mesozoic strata (see Tables 3-9), and extends into the Oligocene (Cookson and Pike 1954).

Genus **Podosporites** Rao 1943

TYPE SPECIES: *Podosporites tripakshi* Rao 1943.

Podosporites microsaccatus (Couper) comb. nov.

(Pl. XXVI, fig. 6, 7)

1953 *Dacrydium microsaccatum* Couper, p. 35; Pl. 4, fig. 38.
1953 *Trichotomosulcites subgranulatus* Couper, p. 64; Pl. 8, fig. 127, 128.
1954 *Trisaccites micropterus* Cookson & Pike, p. 64; Pl. 2, fig. 21-29.
1957 *Podosporites micropterus* (Cookson & Pike) Balme, p. 34; Pl. 9, fig. 101-103.
1960 *Trisaccites microsaccatum* (Couper) Couper, p. 46; Pl. 4, fig. 12, 13.

DIMENSIONS: Corpus diameter 25 (34) 45 μ. Saccus; breadth 5 (7) 11 μ, length 11 (20) 28 μ.

DISTRIBUTION: In E. Australia the species is known from Upper Mesozoic (see Tables 3-9) and early Tertiary strata (Cookson and Pike 1954). Other recorded occurrences include Bajocian-Aptian of Western Australia (Balme 1957) and Albian-Maastrichtian of New Zealand (Couper 1953, 1960).

TURMA PLICATES Naumova 1939

Subturma MONOCOLPATES Iversen & Troels-Smith 1950

Genus **Ginkgocycadophytus** Samoilovitch 1953

TYPE SPECIES: *Ginkgocycadophytus caperatus* (Luber) Samoilovitch 1953.

Ginkgocycadophytus nitidus (Balme) de Jersey 1962

(Pl. XXVI, fig. 8, 9)

1957 *Entylissa nitidus* Balme, p. 30; Pl. 6, fig. 78-80.
1962 *Ginkgocycadophytus nitidus* (Balme) de Jersey, p. 12; Pl. 5, fig. 1-3.

DESCRIPTION: Grains tenuate distally; amb elliptical. Tenuitas extending full length of grain; broader at equator than at pole. Exine 1 μ thick, smooth to faintly scabrate.

DIMENSIONS: Equatorial diameter; length 34 (44) 56 μ, breadth 14 (26) 36 μ.

REMARKS: The SE. Australian specimens are identical to the type and other specimens which are illustrated by Balme (1957) and which are 33-46 μ in length and 19-26 μ in breadth (cf. the size range quoted by Balme 1957, p. 30). The species is similar to many of the Mesozoic grains that have been attributed to *Monosulcites minimus* Cookson; the holotype of Cookson's species (1947; Pl. 15, fig. 48) has a convexly elliptical tenuitas, and is distinct from *Ginkgocycadophytus nitidus* (Balme).

DISTRIBUTION: Apparently widespread in Australian Jurassic and Cretaceous sediments, with previous records from Lower Jurassic-Lower Cretaceous of Western Australia (Balme 1957) and Lower Mesozoic of Queensland (de Jersey 1959, 1962). The species is represented in almost all the Upper Mesozoic samples examined from SE. Australia (see Tables 3-9).

TURMA POROSES Naumova emend. Potonié 1960

Subturma MONOPORINES Naumova 1939

Genus **Classopollis** Pflug emend. Pocock & Jansonius 1961

TYPE SPECIES: *Classopollis classoides* Pflug emend. Pocock & Jansonius 1961.

DISCUSSION: Following a review of the literature, and after an examination of European and Canadian specimens attributable to *Classopollis classoides* Pflug, Pocock and Jansonius (1961) emended the diagnosis of *Classopollis* Pflug. Furthermore, these authors concluded that the type species is specifically distinct from previously described species assignable to *Classopollis*. However, they note in an addendum to their paper that *Corollina* Maljavikina has priority over *Classopollis* if the two genera are proven identical.

The genus shows world-wide distribution in Mesozoic sediments with earliest known occurrences in Rhaetic strata (Chaloner and Clarke 1962); the Permian species, *C. belloyensis* Pocock & Jansonius, is considered by Chaloner and Clarke (1962) to be closely allied to *Vittatina* Luber.

AFFINITY: Couper (1953, 1958) demonstrated that *Classopollis* and the pollen grains associated with *Pagiophyllum connivens* Kendall are similar in morphology. Pocock and Jansonius (1961, p. 448) suggest that species of *Cheirolepis* Schimper, *Brachyphyllum* Brongn., and *Pagiophyllum* Heer may have 'produced *Classopollis*-type pollen'.

Classopollis cf. **C. classoides** Pflug emend.
Pocock & Jansonius 1961
(Pl. XXVI, fig. 10-14)

DIMENSIONS: Equatorial diameter 31 (39) 50 μ; polar diameter 25 (31) 39 μ.

REMARKS: Except for their larger size the SE. Australian specimens conform with Pocock and Jansonius' (1961, p. 443) definition of *Classopollis classoides* Pflug. The surface pattern of the 'belt averaging 9 microns in width surrounding the equator' comprises a series of narrow channels which parallel the equator and which are connected by short, transverse channels (see Chaloner and Clarke 1962; Pl. 80, fig. 2-4: present study, Pl. XXVI, fig. 13). Well preserved specimens recovered in the present investigation show that the proximal pole is enclosed within a cone composed of minute, petal-like, exinal elements (se Pl. XXVI, fig. 11, 12, 14).

DISTRIBUTION: This form is widly dispersed in Upper Mesozoic sediments of SE. Australia (see Tables 3-9).

TURMA ALETES Ibrahim 1933

Subturma AZONALETES Luber emend. Potonié & Kremp 1954

Genus **Araucariacites** Cookson ex Couper 1953

TYPE SPECIES: *Araucariacites australis* Cookson 1947.

Araucariacites australis Cookson 1947
(Pl. XXVI, fig. 15)

DIMENSIONS: 50 (68) 91 μ in maximum diameter.

AFFINITY: Cookson (1947) and Cookson and Duigan (1951) compared Kerguelen and Australian Tertiary *Araucariacites australis* Cookson with pollen from fossil and modern araucariacian species. Couper (1958) has shown that British Mesozoic specimens of the species are comparable to grains of the Jurassic *Brachyphyllum mamillare* Brongn.

DISTRIBUTION: Described from Lower Tertiary lignites of Kerguelen (Cookson 1947), and widely reported in Mesozoic and Tertiary strata from other parts of the world. The species is widely distributed in the Upper Mesozoic of SE. Australia (see Tables 3-9).

Genus **Spheripollenites** Couper 1958

TYPE SPECIES: *Spheripollenites scabratus* Couper 1958.

Spheripollenites psilatus Couper 1958

(Pl. XXVI, fig. 16, 17)

DIMENSIONS: Diameter 20 (28) 36 μ.

DISTRIBUTION: Described from Wealden and Aptian sediments of Britain (Couper 1958), and recorded herein from the Upper Mesozoic of SE. Australia (see Tables 3-9).

INCERTAE SEDIS

Genus **Schizosporis** Cookson & Dettmann 1959

TYPE SPECIES: *Schizosporis reticulatus* Cookson & Dettmann 1959.

REMARKS: There is now little doubt that both *Ovoidites* Potonié ex Krutzsch and *Schizosporis* Cookson & Dettmann incorporate spheroidal to ellipsoidal spores which separate into two approximately equal parts along a line of weakness at the equator. *Ovoidites* was introduced by Potonié in 1951, but the genus remained invalid until April 1959 (Krutzsch 1959, p. 249) when Cookson and Dettmann validly instituted *Schizosporis*. The latter name is retained by the present writer for the Mesozoic spores described below.

Cookson and Dettmann (1959b) noted that *Schizosporis* resembles certain Mesozoic species which Bolkhovitina (1956; see also 1959) attributed to *Psophosphaera* Naumova, and similar Mesozoic spores have been described under the name *Planorbina* Maljavikina (1949). Alete spores which split equatorially are known also from the Carboniferous, and these spores have been assigned to *Retialetes* Staplin.

Schizosporis reticulatus Cookson & Dettmann 1959

(Pl. XXVI, fig. 20, 21)

DIMENSIONS: Equatorial diameter 94 (132) 172 μ.

DISTRIBUTION: Widely distributed in the Upper Mesozoic of E. Australia (Cookson and Dettmann 1959b; present study, Tables 4-9). The species is known also from Upper Neocomian beds of Canada (Pocock 1962).

Schizosporis rugulatus Cookson & Dettmann 1959

(Pl. XXVI, fig. 22, 23)

1959 *Schizosporis rugulatus* Cookson & Dettmann, p. 216; Pl. 1, fig. 5-9.
1962 non *Schizosporis rugulatus* Cookson & Dettmann: Pocock, p. 76; Pl. 13, fig. 203, 204.

DIMENSIONS: (8 specimens) Equatorial diameter 86 (96) 108 μ.

TABLE 3

Distribution of spore and pollen species in samples from the lowermost parts of the Mesozoic sequences intersected in Cootabarlow Bore No. 2 and Penola Bore No. 1. In the core samples that yielded sufficiently well-preserved microfloras, constituent species are recorded as percentages which are based on individual counts of 250 specimens. 'X' indicates observed presence in a particular sample, but not in actual count; 'cf' indicates presence of specimens similar to, but not identical with, a particular species.

OTWAY BASIN	GREAT ARTESIAN BASIN						
PENOLA BORE No.1	COOTABARLOW BORE No.2						
4766-76 ft	1471-72 ft	1469-70 ft	1465-68 ft	1447-64 ft	1447 ft		
5.3	0.6	3.3	3.3	X	X	Cyathidites australis	LAEVIGATI
5.3	6.0	3.3	6.6		0.6	C. minor	
	X	X			X	C. asper	
	0.6	0.6	X			C. concavus	
	8.0	3.3	3.3	X	2.0	Stereisporites antiquasporites	
X						Biretisporites cf. B. potoniaei	
	X	X	X			B. spectabilis	
0.6	X	2.0	2.0	X	X	Dictyophyllidites crenatus	
2.0			0.6	X		Leptolepidites verrucatus	APICULATI
11.3	2.6	2.0	3.3	X	0.6	Osmundacidites wellmanii	
8.0	3.3	8.0	12.6	X	4.6	Baculatisporites comaumensis	
X	0.6	X	1.3	X	1.3	Neoraistrickia truncatus	
2.0	2.0	2.0	3.3	X	X	Ceratosporites equalis	
	X	X	0.6	X		Lycopodiacidites asperatus	MURORNATI
		X	X	X		Tripartina cf. T. variabilis	
	X	X	X	X	X	Cyclosporites hughesi	
X	X	X	X	X	X	Foveotriletes parviretus	
	X	0.6	X		X	Foveosporites canalis	
1.3	4.0	2.0	6.6	X	X	Lycopodiumsporites austroclavatidites	
X	X	X	X	X	X	L. circolumenus	
1.3	2.6	2.0	6.0	X	1.3	L. reticulumsporites	
X	2.0	X	2.6	X	0.6	L. eminulus	
X	X	X	X	X	X	L. nodosus	
		X				L. facetus	
	X	0.6	1.3	X		Reticulatisporites pudens	
			X			Klukisporites scaberis	
	X		X	X	X	Dictyotosporites complex	
	X					Cicatricosisporites australiensis	
		X			0.6	Matonisporites cooksoni	AURICULATI
	X	X	X	X		Ischyosporites punctatus	
0.6	6.0	3.3	8.0	X	2.0	Cleicheniidites cf. G. cercinidites	TRICRASSATI
	X			X		Sestrosporites pseudoalveolatus	
X	X	X	0.6	X	X	Coronatispora perforata	
	0.6	0.6	0.6		0.6	Cingutriletes clavus	CINGULATI
		X	X	X	X	Murospora florida	
		X	X		X	Contignisporites cooksonii	
		X				Kraeuselisporites linearis	
	cf	cf	cf	cf		Minerisporites marginatus	
X	0.6	0.6	X	X	X	Crybelosporites stylosus	PERINOTRILITES
X	X	X	X	X	X	Velosporites triquetrus	
		X	X	X	X	Densoisporites velatus	
X			X			Aequitriradites verrucosus	HILATES
		X				Reticuloidosporites arcus	MONOLETES
0.6	0.6	X	X	X		Tsugaepollenites dampieri	SACCITES
	X	X	X			T. trilobatus	
		X	X		X	T. cf. T. segmentatus	
6.6	3.3	4.6	10.6	X	6.0	Alisporites grandis	
X	2.6	1.3	1.3	X	1.3	A. similis	
5.3	16.0	14.0	6.6	X	11.3	Podocarpidites cf. P. ellipticus	
X	1.3	1.3	X			P. cf. P. multesimus	
	0.6	1.3	X	X	1.3	Podosporites microsaccatus	
4.6	22.0	30.6	10.0	X	18.6	Microcachyridites antarcticus	
6.6	2.6	1.3	2.6		0.6	Ginkgocycadophytus nitidus	PLICATES
X	4.0	7.3	2.6	X	4.6	Classopollis cf. C. classoides	POROSES
6.0	4.0	X	2.6	X	1.3	Araucariacites australis	ALETES
11.3	8.0	3.3	2.0	X	3.3	Spheripollenites psilatus	

COMPARISON: *Schizosporis rugulatus* Cookson & Dettmann shows finer sculpture and is larger in size than the Canadian spores which Pocock (1962) assigned to the species.

DISTRIBUTION: Recovered from the uppermost horizons of the Upper Mesozoic succession in the Great Artesian and Otway Basins (Cookson and Dettmann 1959b; present study, Tables 5-7, 9).

Schizosporis spriggi Cookson & Dettmann 1959

(Pl. XXVI, fig. 24)

DIMENSIONS: Equatorial diameter 67 (90) 111 μ.

COMPARISON: *Schizosporis grandis* Pocock is larger and ellipsoidal in shape.

DISTRIBUTION: The species is of infrequent occurrence, and shows wide distribution in the Upper Mesozoic of SE. Australia (Cookson and Dettmann 1959b; present study, Tables 4-9). It has been reported from Neocomian-Albian strata of Canada (Pocock 1962).

Schizosporis parvus Cookson & Dettmann 1959

(Pl. XXVI, fig. 18, 19)

DIMENSIONS: (10 specimens) Equatorial diameter; length 67 (77) 89 μ, breadth 37 (52) 45 μ. Polar diameter 31 (40) 53 μ.

COMPARISON: This species is characteristically ellipsoidal in shape and is distinct from the larger spheroidal spores of *Schizosporis spriggi* Cookson & Dettmann. *S. parvus* Cookson & Dettmann is distinct also from *S. cooksoni* Pocock which is smaller and has a thinner exine.

DISTRIBUTION: Reported from the upper horizons of the Upper Mesozoic sequences in the Otway and Great Artesian Basins (Cookson and Dettmann 1959b; present study, Tables 5-9), and from Upper Neocomian strata of Canada (Pocock 1962).

Microfloral Assemblages and Stratigraphical Applications

One of the purposes of the present investigation was to evaluate the stratigraphical value of the dispersed-spore species, described herein. and to utilize the spores in the correlation of SE. Australian Upper Mesozoic strata. As outlined below, three, successive, distinct microfloral assemblages are distinguishable in the partly marine sequence of the Great Artesian Basin and in deposits examined from elsewhere in SE. Australia. Each of the microfloral assemblages is characterized by distinctive species of restricted stratigraphical ranges and thus of considerable correlative value both within and without SE. Australia. Concomitant evidence for the ages of the microfloras is assessed.

In addition, quantitative analyses of the spore assemblages studied from cores and cuttings of the more comprehensively sampled bore sequences are presented. Although these analyses probably provide some information concerning the general composition of the contamporaneous flora, collecting has been insufficiently detailed to permit refined correlations on the basis of changes in abundance of constituent species (cf. Couper 1958).

THE MICROFLORAL SUCCESSION

The most comprehensive collections that have been available for study are from marine and non-marine strata intersected by Oodnadatta (Santos) Bore No. 1 and

Basin	Bore	Depth	LAEVIGATI									APICULATI										MURORNATI																						AURICULATI				TRI-CRASSATI				CINGULATI										PERINO-TRILITES				HILATES										MONOLETES		SACCITES									PLICATES	POROSES	ALETES		INCERTAE SEDIS	
			Cyathidites australis	C. minor	C. punctatus	C. asper	C. concavus	Stereisporites antiquasporites	Biretisporites cf. B. potoniaei	B. spectabilis	Dictyophyllidites crenatus	Leptolepidites verrucatus	L. major	Osmundacidites wellmanii	O. mollis	Baculatisporites comaumensis	Neoraistrickia truncatus	Ceratosporites equalis	Pilosisporites notensis	P. parvispinosus	Kuylisporites lunaris	Lycopodiacidites asperatus	Tripartina cf. T. variabilis	Cyclosporites hughesi	Foveotriletes parviretus	Foveosporites canalis	Lycopodiumsporites austroclavatidites	L. circolumenus	L. reticulumsporites	L. eminulus	L. nodosus	L. facetus	Reticulatisporites pudens	Klukisporites scaberis	Dictyotosporites speciosus	D. complex	D. filosus	Januasporites spinulosus	Staplinisporites caminus	Cicatricosisporites australiensis	C. ludbrooki	C. hughesi	Pyrobolospora reticulata	Matonisporites cooksoni	Trilobosporites purverulentus	Trilites cf. T. tuberculiformis	Ischyosporites punctatus	Gleicheniidites cf. C. circinidites	Sestrosporites pseudoalveolatus	Coronatispora perforata	T. telata	Cingutriletes clavus	Murospora florida	Foraminisporis wonthaggiensis	F. dailyi	F. asymmetricus	Contignisporites cooksoni	C. fornicatus	C. multimuratus	Kraeuselisporites linearis	Minerisporites marginatus	Crybelosporites striatus	C. punctatus	Velosporites triquetrus	Densoisporites velatus	Coptospora striata	C. sp. B	Cooksonites variabilis	Aequitriradites verrucosus	A. spinulosus	A. tilchaensis	Rouseisporites reticulatus	R. simplex	R. radiatus	Couperisporites tabulatus	Laevigatosporites ovatus	Reticuloidosporites arcus	Tsugaepollenites dampieri	T. trilobatus	T. cf. T. segmentatus	Alisporites grandis	A. similis	Podocarpidites cf. P. ellipticus	P. cf. P. multesimus	Podosporites microsaccatus	Microcachryidites antarcticus	Ginkgocycadophytus nitidus	Classopollis cf. C. classoides	Araucariacites australis	Spheripollenites psilatus	Schizosporis reticulatus	S. spriggi
GREAT ARTESIAN BASIN	OODNADATTA BORE No. 1	642 ft	1.3	4.6	X	X		24.6				X	X	X		3.3	1.3	3.3	X	X							0.6		1.3		X	X	X			X				X							X	7.3				2.0		X		X						X			X							0.6						0.6			2.0	0.6	3.3		1.3	4.6	1.3	1.3	14.0	10.0		
		743 ft	1.3	4.0	1.3			21.3				X	X	2.0		6.6	X	8.6	X	X		X		0.6				X	2.6	X	2.0	X	1.3	X	X	X	X			X				X				3.3	X					X	X	X			X					X								X						X	X		10.0	0.6	6.0		X	9.3	2.6	1.3	3.3	5.3	X	X
		842 ft	8.0	9.3	0.6	X		14.0		X		2.6		X		4.6	X	4.3	X					1.3		0.6	4.6	X	3.6	0.6	X	X	1.3	X	0.6	X				0.6				X			X	2.6				X		X		X								X				X													8.0	0.6	6.6		X	3.6	1.3	X	7.3	4.6	X	X
		862 ft	3.3	6.6	X			24.0			1.3	1.3		1.3		3.3	X	2.6	X					X			2.0	X	0.6	2.0	X	X	1.3		X					X								4.6				0.6			X									X														0.6			5.3	1.3	10.6		X	6.0	3.3	0.6	6.6	4.0		
		914 ft	2.6	6.6	X	X	X	14.0			1.3			0.6		2.0	1.3	2.0								X	4.6	X	1.3	1.3	X	0.6	3.3		X					X	X			0.6				4.6	X							X								X														0.6	X		5.3		11.3		1.3	6.0	1.0	0.6	2.0	13.3		
		964 ft	0.6	6.6	X	X	X	6.0		X	0.6			X		2.6	0.6	3.3	X		X	0.6			X		3.6	X		2.0		X			X	X				X				X	X	X	X	7.0							0.6		X			X			0.6	X	X			X		X		X						X			4.6	2.0	7.3	X		5.3	0.6	6.0	1.3	16.6		X
		1052-61 ft	X	X	X	X	X	X			X			X		X	X	X	X					X		X	X	X	X	X	X	X			X	X			X	X				X				X	X	X		X		X	X	X	X								X			X	X			X						X	X		X	X	X		X	X		X	X	X	X	
		1087-92 ft	X	X	X		X	X			X	X	X	X		X	X	X	X						X	X		X	X	X	X		X	X						X						X	X	X								X				X											X		X						X			X	X	X			X	X	X	X	X		
		1147-52 ft	X	X	X	X	X									X		X	X								X	X	X	X						X									X			X	X	X																																										
		1213 ft	1.3	11.3				7.3			X	X				4.0	2.0	2.6	X			X	1.3		X	X	6.6	X	2.0				1.3		X	X				X	X			0.6			X	12.6	X	X				X		?	X							X	X					X								0.6	X	X	2.6	2.0	3.3	X		0.6	0.3	12.0	2.0	10.0	X	
		1227-32 ft	X	X			X	X				X	X	X	X	X	X	X	X				X	X			X	X	X	X	X	X	X	X	X					X							X	X					X	X	?		X		X	X					X					X		X						X	X		X	X	X	X	X	X	X	X	X	X		
		1287-92 ft	X	X				X			X		X										X	X			X			X	X	X	X			X											X	X		X																												X		X	X	X	X			X	X	X	X			
	COOTABARLOW BORE No. 2	1330-48 ft	X	X	X	X	X	X			X	X		X		X	X	X	X		X	X	X	X	X	X	X	X	X	X	X		X		X	X		X		X				X	X		X	X				X		X	X	X	X	X			cf				X				X	X		X	X					X	X	X	X	X	X	X		X	X	X	X	X	X	
		1340 ft	0.6	4.6	X	X		4.6		X	X			X		8.0	0.6	2.6			X	X			X		2.0	X	0.6	2.6			X		X					X				0.6	0.6	X	X	4.0				X		X	X	X	X				cf											X	X							X	10.6	2.0	10.0	1.3	1.3	12.0	3.3	3.3	12.0	10.0		
		1348-52 ft	X	X	X	X	X				X	X	X	X		X	X	X	X	X	X	X		X			X	X	X		X		X		X					X	X	X		X	X	X	X	X			X			X	X	X	X	X	X					X	X				X	X		X						X			X	X	X	X	X	X		X	X	X		
		1354 ft	6.6	5.3	0.6	1.3		12.0				X	X			3.3	0.6	1.3	X							X	0.6	X	X	X			X	X	X	X				0.6		X		X	X		X	8.0		X		X		0.6	X	1.3	X						X	X	X				X	X		3.3					X	X	X	X	8.6	X	7.3		0.6	16.0	2.0	5.3	2.3	16.6		
		1376-77 ft	7.3		X	X		4.6	0.6	X	0.6	X	X	1.3		12.0	2.0	4.0			X	X	X	X	2.0	0.6	3.3	X	3.3	0.6	0.6		X	X	0.6	X		0.6		X	0.6			X			1.3	1.3		X			X	X	1.3	X	X			X	cf			X	X			X	X	X		0.6	X		X					X	11.3	0.6	6.0		0.6	12.0	4.6	4.6	4.6	7.3	X	
		1391-92 ft	8.0	2.0				9.3			0.6	2.0		0.6		9.3	0.6	2.0						X	X		3.3	X	2.6	0.6	0.6		X							X								1.3						2.0	0.6		X				cf				X				X			X	X		X			X	X		4.6	1.3	12.6	0.6	2.0	3.3	4.0	6.0	8.0	11.3		
		1401-02 ft	5.3	4.0	0.6	X	2.0	4.0		X	X	X		2.6		14.0	0.6	2.0			X	X		X	X	X	4.0	0.6	3.3	0.6	X			0.6	X	X				X	0.6			X		0.6	0.6	2.0	X				X	X	X		X	X		X				X	X					X		X	X					X		X	10.0	1.3	6.6			6.6	1.3	4.0	4.6	17.3		
		1403-04 ft	X	X				X								X	X	X									X	X	X			X															X						X	X	X		X															X										X	X			X		X		X		
OTWAY BASIN	PENOLA BORE No. 1	2990-3000 ft	4.6	6.0	0.6	0.6		16.6	X		X	X		X		4.0		2.0	X	X							2.0	X	1.3	X	X		X	X	X	X				2.6				X			X	0.6		X		3.3		X	X	0.6						0.6		X		X	X		X	X		2.0	X	X							6.0	1.3	8.6	X	2.0	11.3	2.6	0.6	10.0	9.3		X
		3180-90 ft	X	X				X				X				X		X	X		X						X		X					X	X					X			X											X		X							X		X														X				X		X			X	X	X		
		3363-73 ft	12.0	14.0	X		0.6	12.0			0.6	0.6	X			1.3	2.6	X	X				0.6	X		X	2.0	X	4.0	4.6	0.6	X	X	0.6	0.6	X	X			0.6				X										0.6	X										X							X								3.3	X	3.3	X	2.0	3.3	6.6	X		22.6		
		3614-24 ft	24.0	8.0	2.0		0.6	10.3	X		1.3	0.6	0.6			1.3	1.3	X	X	X			2.0	0.6	X		3.3	X	2.0	X	X		0.6	X	1.3					X								0.6						X	X									X					X			0.6						X			2.0	X	4.0		2.6	6.0	1.3	1.3	X	20.0		
		3715-21 ft	10.3	16.0			1.3	6.6			2.0	0.6	0.6			4.0	X	4.6	X	X	0.6			X	X		X		0.6	0.6		0.6		X	X	X				1.3	0.6			X			X	2.0						0.6	X													0.6	X	X	X	X				cf			X		5.3		10.3		0.6	10.3	2.6	1.3	3.3	8.6	X	X
		3850-55 ft	20.3	7.3				30.3			1.0	X	X			3.0	2.0	1.6					0.6	X			2.3	X	3.0	2.0	0.3		0.3		1.6													6.0							X									X												cf					6.6		3.3	X	2.0	3.6	0.3	0.6				
		4392 ft	2.6	10.0				6.6	0.6	X	0.6	3.3	0.6	0.6		20.0	3.3	4.6				X		X			4.0	0.6	3.3	1.3	0.6	X	0.6	1.3	X	X								X			X						0.6		X															X									X	X	5.3	1.3	9.3	X		4.6	4.8	0.6	4.0	8.5		
		4618 ft	1.3	10.6				5.3	0.6	X	1.3	2.0	X	8.6		18.6	2.0	5.3						X	X		3.3	X	4.0	2.6	X	X	1.3	X	X	X								X				0.6	X				X	X			X		X	X				X						X									X	X	4.0	2.0	7.3	0.6	0.6	2.0	6.0	2.0	6.0			
	ROBE BORE No. 1	3325 ft	12.0	13.6	X	X		9.6	X		X	0.6	X	2.3		6.0	0.3	1.0	X	X			1.0			X	2.6			0.3	0.3	X	0.3	X	X			X		1.0			X	X			X	X				X		X	0.3	0.3					cf	X								X		0.6					X				2.3	X	9.3	X	2.3	9.6	1.6	0.3	1.6	11.3	X	
		3500 ft	5.0	14.5	X	X		22.0	0.5		X	0.5	X	2.0	X	4.5	X	3.0	X				0.5				1.5			0.5	X	X	X	0.5	X					1.0			X	X				0.5				0.5		X	X	X						1.0		X								0.5	X	X		cf					2.0	0.5	9.0	X	4.5	14.0	4.5	0.5	2.5	3.5	X	X
		3860 ft	15.0	5.0	X	X		5.6	X	X	1.6	1.6	X	0.3	X	6.3	X	3.0	0.3	X	0.3		0.6	X	0.3		4.6	X	3.0	0.6	0.6	X	X	X	0.3	X			X	1.3	X			X			X	X		X			?	0.3	1.0					X	cf			X				X		X	X	X									2.0	0.3	11.0	X	0.6	7.3	3.3	1.3	X	19.6	X	X
		4300 ft	10.3	6.3		X		15.3	X		6.6	0.3	X	X		5.3	X	2.3	0.3	X	X		0.6	0.3			2.3	X	1.3	0.3	X	X	1.3	1.6	X	X				0.3				X				X	X					0.3	0.3					X				X					X												5.6	X	8.6	X	1.0	5.3	1.0	2.3	1.0	16.6	X	

TABLE 4

Distribution of spore and pollen species in Mesozoic samples (succeeding those documented in Table 3) from Cootabarlow Bore No. 2 and Penola Bore No. 1, and in samples from the lower parts of the Mesozoic sequences in Oodnadatta Bore No. 1 and Robe Bore No. 1. In the core and cutting samples that yielded sufficiently well-preserved microfloras, constituent species are recorded as percentages which are based on individual counts of 250 specimens. 'X' indicates observed presence in a particular sample, but not in actual count; 'cf' indicates presence of specimens similar to, but not identical with, a particular species; '?' denotes that only doubtful representatives of a species have been observed.

Corrigendum: In the list of species *T. telata* should read *C. telata*.

Basin	Bore	Depth	LAEVIGATI								APICULATI										
			Cyathidites australis*	C. minor*	C. punctatus	C. asper*	Stereisporites antiquasporites*	Biretisporites cf. B. potoniaei	Dictyophyllidites crenatus	D. pectinataeformis	Leptolepidites verrucatus	L. major	Concavissimisporites penolaensis	Osmundacidites wellmanii*	Baculatisporites comaumensis*	Neoraistrickia truncatus	Ceratosporites equalis*	Pilosisporites notensis	P. parvispinosus	P. grandis	Kuylisporites lunaris
Great Artesian Basin	Oodnadatta Bore No. 1	87 ft	2.6	14.0		X	13.3								1.3		X				
Great Artesian Basin	Oodnadatta Bore No. 1	127 ft	X	X			X								X						
Great Artesian Basin	Oodnadatta Bore No. 1	167 ft	3.3	9.3		X	24.6				X			0.6	4.6	0.6	4.6				
Great Artesian Basin	Oodnadatta Bore No. 1	248 ft		9.3	1.3		18.0							X	1.3		X				
Great Artesian Basin	Oodnadatta Bore No. 1	327 ft	1.3	10.6	X	X	16.0								2.0		1.3			X	
Great Artesian Basin	Oodnadatta Bore No. 1	407 ft	2.0	5.3	0.6	X	22.0							0.6	X		X				
Great Artesian Basin	Oodnadatta Bore No. 1	447 ft	3.3	4.0	0.6	2.0	24.0				0.6			X	5.3	X	1.3		X	X	
Great Artesian Basin	Oodnadatta Bore No. 1	557 ft	2.0	2.0	X		25.3				X	X		0.6	8.0	X	2.0	X	X		
Great Artesian Basin	Cootabarlow Bore No. 2	581 ft	X	13.3	X	0.6	3.3							X	0.6		1.3		X	X	
Great Artesian Basin	Cootabarlow Bore No. 2	581-603 ft	X	X	X	X	X				X	X			X		X			X	
Great Artesian Basin	Cootabarlow Bore No. 2	660-80 ft	X	X	X	X	X								X		X			X	
Great Artesian Basin	Cootabarlow Bore No. 2	770-880 ft	X	X	X	X	X		X					X	X	X	X			X	X
Great Artesian Basin	Cootabarlow Bore No. 2	810-20 ft	X	X	X		X								X		X		X		
Great Artesian Basin	Cootabarlow Bore No. 2	1040-50 ft	X	X	X		X		X		X			X	X		X				
Otway Basin	Penola Bore No. 1	1200-1210 ft	0.5	14.0		X	19.0								3.0						
Otway Basin	Penola Bore No. 1	1400-1418 ft	4.0	21.5			10.5							1.0	18.0	1.0	1.5			X	
Otway Basin	Penola Bore No. 1	1610-20 ft	3.3	12.3	X	1.3	7.3	X					X	2.6			X				
Otway Basin	Penola Bore No. 1	1805-15 ft	4.3	21.0	0.6	X	2.6			X			X	1.0	6.3	X	0.3			X	
Otway Basin	Penola Bore No. 1	2010-20 ft	4.0	15.5	X	1.0	12.5								6.0	X	1.5				X
Otway Basin	Penola Bore No. 1	2200-2210 ft	X	X			X									X					
Otway Basin	Penola Bore No. 1	2380-90 ft	2.0	9.0	4.3	X	6.6								2.3						
Otway Basin	Penola Bore No. 1	2586-96 ft	2.0	5.3	0.6	8.6	12.6						X		X			X		0.6	
Otway Basin	Penola Bore No. 1	2790-98 ft	0.6	8.0	0.6	1.3	30.6					X	X	X	5.3		0.6	X	X		
Otway Basin	Robe Bore No. 1	1400 ft	3.8	17.0	X	3.6	X	1.3		X			X							0.3	
Otway Basin	Robe Bore No. 1	1780 ft	2.6	7.3	X	0.6	3.6	5.3			X			1.3	5.0	X	X			X	
Otway Basin	Robe Bore No. 1	2325 ft	4.5	9.0	X	X	4.5	3.0			X			0.5	0.5		X				
Otway Basin	Robe Bore No. 1	2630 ft	3.5	7.5	0.5	X	7.0				X			1.5	5.5	X	1.0		X		

Basin	Bore	Depth	MURORNATI																							
			Lycopodiacidites asperatus	Tripartina cf. T. variabilis*	Foveotriletes parviretus	Foveosporites canalis	Lycopodiumsporites austroclavatidites*	L. circolumenus	L. reticulumsporites	L. eminulus	L. nodosus*	L. facetus	Reticulatisporites pudens	Klukisporites scaberis	Dictyotosporites speciosus	D. complex	D. filosus	Januasporites spinulosus	Cicatricosisporites australiensis*	C. ludbrooki	C. pseudotripartitus	C. hughesi*	Balmeisporites holodictyus*	B. tridictyus	Pyrobolospora hexapartita	P. reticulata
Great Artesian Basin	Oodnadatta Bore No. 1	87 ft					1.3		1.3										X			X				
Great Artesian Basin	Oodnadatta Bore No. 1	127 ft					X				X		X													
Great Artesian Basin	Oodnadatta Bore No. 1	167 ft	X				1.3			0.6		X		X		X							X			X
Great Artesian Basin	Oodnadatta Bore No. 1	248 ft					1.3												0.6			X				
Great Artesian Basin	Oodnadatta Bore No. 1	327 ft					1.3	0.6	X		X	X	1.3			X			X		X	X				
Great Artesian Basin	Oodnadatta Bore No. 1	407 ft					2.6		1.3										2.0			0.6	X			
Great Artesian Basin	Oodnadatta Bore No. 1	447 ft					2.0				X		1.3						2.0			0.6	X			
Great Artesian Basin	Oodnadatta Bore No. 1	557 ft					2.0		0.6	0.6	0.6	X	1.3	X					2.6			0.6				
Great Artesian Basin	Cootabarlow Bore No. 2	581 ft	0.6				0.6		0.6		X								X			0.6	X			X
Great Artesian Basin	Cootabarlow Bore No. 2	581-603 ft					X		X										X		X	X	X	X		
Great Artesian Basin	Cootabarlow Bore No. 2	660-80 ft					X		X			X							X		X	X	X			
Great Artesian Basin	Cootabarlow Bore No. 2	770-880 ft			X		X		X	X	X		X						X			X				
Great Artesian Basin	Cootabarlow Bore No. 2	810-20 ft					X	X	X		X		X						X			X		X		
Great Artesian Basin	Cootabarlow Bore No. 2	1040-50 ft	X	X	X		X		X		X		X	X					X		X	X			X	X
Otway Basin	Penola Bore No. 1	1200-1210 ft		X			2.0		X										X							
Otway Basin	Penola Bore No. 1	1400-1418 ft					9.0		2.5										3.5			X				
Otway Basin	Penola Bore No. 1	1610-20 ft		0.3			0.3		X										1.3		X	51.6	X			
Otway Basin	Penola Bore No. 1	1805-15 ft		X			1.0		X			X							19.3		X	22.0	X	X		X
Otway Basin	Penola Bore No. 1	2010-20 ft				X	2.0		1.5	X									2.0				X			X
Otway Basin	Penola Bore No. 1	2200-2210 ft					X												X							
Otway Basin	Penola Bore No. 1	2380-90 ft					X						X					0.6	6.6				0.3			
Otway Basin	Penola Bore No. 1	2586-96 ft							0.6										10.0				2.0			
Otway Basin	Penola Bore No. 1	2790-98 ft		X			0.6		0.6	0.6	X		0.6		X		X		10.0	1.3		X	X		X	X
Otway Basin	Robe Bore No. 1	1400 ft	X	X			0.3												3.0			X	0.6	X	X	X
Otway Basin	Robe Bore No. 1	1780 ft				X	3.0		2.3			X							1.0			X	X	X	X	X
Otway Basin	Robe Bore No. 1	2325 ft		0.5		0.5	1.0		X										2.0							
Otway Basin	Robe Bore No. 1	2630 ft	X				1.0		1.5	X			X	X		X			14.0				X			

Basin	Bore	Depth	AURICULATI						TRICRASSATI			CINGULATI							
			Matonisporites cooksoni	Trilobosporites trioreticulosus	T. purverulentus	T. tribotrys	Trilites cf. T. tuberculiformis*	Ischyosporites punctatus	Gleicheniidites cf. G. cercinidites*	Sestrosporites pseudoalveolatus	Coronatispora telata	Cingutriletes clavus	Foraminisporis wonthaggiensis*	F. dailyi*	F. asymmetricus	Contignisporites glebulentus	C. fornicatus	Kraeuselisporites majus	Minerisporites marginatus
Great Artesian Basin	Oodnadatta Bore No. 1	87 ft							21.3			2.0	X	X	X		X		
Great Artesian Basin	Oodnadatta Bore No. 1	127 ft							X										
Great Artesian Basin	Oodnadatta Bore No. 1	167 ft							11.3			0.6			X				
Great Artesian Basin	Oodnadatta Bore No. 1	248 ft		X			X		24.3			X			X				
Great Artesian Basin	Oodnadatta Bore No. 1	327 ft		X					22.0			0.6	X	X	X			X	
Great Artesian Basin	Oodnadatta Bore No. 1	407 ft		X					14.6				0.6		0.6			X	
Great Artesian Basin	Oodnadatta Bore No. 1	447 ft		X			X		10.6			1.3	X	X	X	X			
Great Artesian Basin	Oodnadatta Bore No. 1	557 ft							2.6				1.3		X	X			
Great Artesian Basin	Cootabarlow Bore No. 2	581 ft	X	X			X		20.0			X	X	X	X			X	
Great Artesian Basin	Cootabarlow Bore No. 2	581-603 ft	X	X			X	X	X			X		X	X	X			
Great Artesian Basin	Cootabarlow Bore No. 2	660-80 ft	X	X	X	X	X	X	X			X	X	X	X	X	X	X	
Great Artesian Basin	Cootabarlow Bore No. 2	770-880 ft	X	X			X	X	X			X	X	X	X			X	
Great Artesian Basin	Cootabarlow Bore No. 2	810-20 ft					X	X	X			X	X	X	X			X	
Great Artesian Basin	Cootabarlow Bore No. 2	1040-50 ft							X			X	X	X	X			X	
Otway Basin	Penola Bore No. 1	1200-1210 ft							0.5	0.5		0.5	X		0.5			X	
Otway Basin	Penola Bore No. 1	1400-1418 ft										2.5	0.5		X			0.5	
Otway Basin	Penola Bore No. 1	1610-20 ft							3.3									X	
Otway Basin	Penola Bore No. 1	1805-15 ft	4.0	X		X			0.6					X	1.3	X		X	
Otway Basin	Penola Bore No. 1	2010-20 ft	0.5						1.5			X	0.5	0.5	1.0			X	
Otway Basin	Penola Bore No. 1	2200-2210 ft	X						X										
Otway Basin	Penola Bore No. 1	2380-90 ft				X			0.3				1.3		1.0				
Otway Basin	Penola Bore No. 1	2586-96 ft	0.6	X		X		1.3	2.0		X			0.6	2.0				
Otway Basin	Penola Bore No. 1	2790-98 ft	X	X				0.6	1.3			12.0	0.6	0.6	X				
Otway Basin	Robe Bore No. 1	1400 ft	1.6	X		X			3.3						X	X		X	X
Otway Basin	Robe Bore No. 1	1780 ft	X	X		X			2.0			0.3	X	X	5.0			0.6	X
Otway Basin	Robe Bore No. 1	2325 ft							1.5					X	X				
Otway Basin	Robe Bore No. 1	2630 ft	0.5									X			X				

Basin	Bore	Depth	PERINOTRILITES				HILATES									MONOLETES	
			Crybelosporites striatus*	C. punctatus	Velosporites triquetrus*	Densoisporites velatus	Coptospora striata	C. paradoxa	C. sp. A	Aequitriradites verrucosus	A. spinulosus	A. tilchaensis	Rouseisporites reticulatus*	R. simplex	R. radiatus*	Laevigatosporites ovatus*	Microfoveolatosporis canaliculatus
Great Artesian Basin	Oodnadatta Bore No. 1	87 ft	X		X			0.6					X			1.3	
Great Artesian Basin	Oodnadatta Bore No. 1	127 ft																
Great Artesian Basin	Oodnadatta Bore No. 1	167 ft													X			
Great Artesian Basin	Oodnadatta Bore No. 1	248 ft	1.3	X				X					X				
Great Artesian Basin	Oodnadatta Bore No. 1	327 ft	X					X					X	X			
Great Artesian Basin	Oodnadatta Bore No. 1	407 ft						1.3		X	X		X	X			
Great Artesian Basin	Oodnadatta Bore No. 1	447 ft	X					X		X	X		X	X			
Great Artesian Basin	Oodnadatta Bore No. 1	557 ft	1.3														
Great Artesian Basin	Cootabarlow Bore No. 2	581 ft	0.6		X	X		0.6		X	X		X	1.3	0.6		X
Great Artesian Basin	Cootabarlow Bore No. 2	581-603 ft	X					X		X	X		X	X			
Great Artesian Basin	Cootabarlow Bore No. 2	660-80 ft	X			X		X		X	X		X	X	X		
Great Artesian Basin	Cootabarlow Bore No. 2	770-880 ft	X	X				X			X		X	X	X		
Great Artesian Basin	Cootabarlow Bore No. 2	810-20 ft	X					X					X				
Great Artesian Basin	Cootabarlow Bore No. 2	1040-50 ft	X	X				X		X	X		X			X	X
Otway Basin	Penola Bore No. 1	1200-1210 ft	X					0.5		X	X		X	0.5	0.5	X	
Otway Basin	Penola Bore No. 1	1400-1418 ft	1.5								X					0.5	
Otway Basin	Penola Bore No. 1	1610-20 ft	0.3					1.3		X			X	1.0	0.6	5.0	
Otway Basin	Penola Bore No. 1	1805-15 ft	1.0					X		X	1.0		X	0.3	0.6	0.6	
Otway Basin	Penola Bore No. 1	2010-20 ft	0.3					X		X	0.5		0.5	X	2.5	X	
Otway Basin	Penola Bore No. 1	2200-2210 ft														X	
Otway Basin	Penola Bore No. 1	2380-90 ft	0.3				0.3	0.6		0.3	X		9.0	21.3	[illegible]		
Otway Basin	Penola Bore No. 1	2586-96 ft	X					4.0		2.0			X	5.3	X		
Otway Basin	Penola Bore No. 1	2790-98 ft	0.6					X		X	X		0.6	0.6	X		
Otway Basin	Robe Bore No. 1	1400 ft	6.3				0.3			X	X	X	X	5.3	3.0	6.3	
Otway Basin	Robe Bore No. 1	1780 ft	2.3		X			X		X	X		1.0	0.3		X	
Otway Basin	Robe Bore No. 1	2325 ft	X					X		1.5	X		1.0	1.0	X		
Otway Basin	Robe Bore No. 1	2630 ft	0.5		X		1.0	1.5	X		X		6.5	2.0	2.0	0.5	

Basin	Bore	Depth	SACCITES									PLICATES	POROSES	ALETES		INCERTAE SEDIS			
			Tsugaepollenites dampieri	T. trilobatus	T. cf. T. segmentatus	Alisporites grandis*	A. similis	Podocarpidites cf. P. ellipticus*	P. cf. P. multesimus	Podosporites microsaccatus*	Microcachryidites antarcticus*	Ginkgocycadophytus nitidus	Classopollis cf. C. classoides*	Araucariacites australis*	Spheripollenites psilatus*	Schizosporis reticulatus*	S. rugulatus*	S. spriggi*	S. parvus*
Great Artesian Basin	Oodnadatta Bore No. 1	87 ft				1.3		7.3		0.6	11.3	4.0	0.6	2.0	4.0	X		X	X
Great Artesian Basin	Oodnadatta Bore No. 1	127 ft				X	X	X		X	X	X		X	X				
Great Artesian Basin	Oodnadatta Bore No. 1	167 ft	X			8.6	1.3	10.0			5.3	2.0		2.0	1.3	X			
Great Artesian Basin	Oodnadatta Bore No. 1	248 ft				3.3	X	5.3		3.3	4.0		0.6	4.6	10.0				
Great Artesian Basin	Oodnadatta Bore No. 1	327 ft					2.0	5.3			6.6		0.6	2.6	12.6	X			
Great Artesian Basin	Oodnadatta Bore No. 1	407 ft	X			2.0		10.0		0.6	12.0		X	1.3	7.3				
Great Artesian Basin	Oodnadatta Bore No. 1	447 ft				X	1.3	3.3	X	0.6	13.3	0.6	X	3.3	6.0				
Great Artesian Basin	Oodnadatta Bore No. 1	557 ft		X		8.6	3.3	11.3		0.6	9.3	0.6	X	4.6	3.3				
Great Artesian Basin	Cootabarlow Bore No. 2	581 ft				2.6	1.3	15.3		6.0	9.3		X	8.0	9.3	X	X	X	
Great Artesian Basin	Cootabarlow Bore No. 2	581-603 ft				X		X		X	X	X	X	X	X	X			X
Great Artesian Basin	Cootabarlow Bore No. 2	660-80 ft				X		X		X	X		X	X	X				X
Great Artesian Basin	Cootabarlow Bore No. 2	770-880 ft			X	X	X	X			X	X	X	X	X				
Great Artesian Basin	Cootabarlow Bore No. 2	810-20 ft	X			X	X	X		X	X	X	X	X	X	X			
Great Artesian Basin	Cootabarlow Bore No. 2	1040-50 ft				X	X	X		X	X	X	X	X	X				
Otway Basin	Penola Bore No. 1	1200-1210 ft				1.5	1.5	13.5		1.5	12.0	4.0	0.5	4.0	13.5				
Otway Basin	Penola Bore No. 1	1400-1418 ft				7.5	1.5	2.0			1.5	1.5	0.5	2.5	4.5	X			
Otway Basin	Penola Bore No. 1	1610-20 ft				X		0.6			1.0			1.0	2.6				X
Otway Basin	Penola Bore No. 1	1805-15 ft				X		2.6		0.3	0.6	X	X	2.0	4.6	X		X	X
Otway Basin	Penola Bore No. 1	2010-20 ft				3.0	0.3	12.0	X	1.5	13.5	1.5	2.5	7.5	X				X
Otway Basin	Penola Bore No. 1	2200-2210 ft						X							X				
Otway Basin	Penola Bore No. 1	2380-90 ft				0.3		4.3		0.3	[illegible]	X	X		1.6				
Otway Basin	Penola Bore No. 1	2586-96 ft						5.3		4.6	16.6		X	1.3	6.6				
Otway Basin	Penola Bore No. 1	2790-98 ft				6.0	X	3.3		1.3	5.3		0.6	0.6	4.6				
Otway Basin	Robe Bore No. 1	1400 ft					0.3	1.3		2.6	20.6	X	X		1.0		X	X	X
Otway Basin	Robe Bore No. 1	1780 ft			X	2.6	X	8.6	X	2.6	17.0	0.3	3.3	7.0	6.0				X
Otway Basin	Robe Bore No. 1	2325 ft				2.0	0.5	1.5	X	0.5	X	[illegible]	1.3	X	[illegible]				
Otway Basin	Robe Bore No. 1	2630 ft			X	3.0	X	2.5	X	1.0	9.0	1.0	2.0	12.5	3.0				X

TABLE 5

*Distribution of spore and pollen species in samples (succeeding those documented in Table 4) from the upper parts of the Mesozoic sequences in Cootabarlow Bore No. 2, Oodnadatta Bore No. 1, Penola Bore No. 1, and Robe Bore No. 1. In the core and cutting samples that yielded sufficiently well-preserved microfloras, constituent species are recorded as percentages which are based on individual counts of 250 specimens. 'X' denotes observed presence in a particular sample, but not in actual count. Species marked * have been observed in samples (Haddon Downs Bore No. 5 between 452 ft 7 in. and 1,406 ft) of the Winton Formation in the Great Artesian Basin.*

Cootabarlow Bore No. 2 in the Great Artesian Basin and from two non-marine bore sequences (Penola Bore No. 1 and Robe Bore No. 1) in the Otway Basin. Tables 3, 4, and 5 list all the spore species present in samples from each of these bore sequences; wherever practicable, quantitative analyses based on counts of 250 specimens per sample are included. Tables 6 and 7, in which the species are arranged approximately in stratigraphical order of appearance, illustrate the microfloral succession in the bore sequences of the Great Artesian Basin and Otway Basin respectively. From these tables it will be seen that, although some of the species are ubiquitous, others possess restricted vertical distribution in each sedimentary basin. Certain of the distinctive species possessing restricted vertical distribution are diagnostic of the three microfloral categories here delineated. For convenience, these microfloral categories are named from their most consistently occurring diagnostic species. A detailed account of the three microfloral assemblages, and of their stratigraphical occurrence in the four bore sections is presented below.

The Stylosus Assemblage

This assemblage (see Tables 3 and 6) was identified in non-marine samples from the 1,447-72 ft interval in Cootabarlow Bore No. 2 and at 4,766-76 ft in Penola Bore No. 1. The Cootabarlow deposits are probable equivalents of the Blythesdale Group (Condon et al. 1960, Ludbrook 1963a) and underlie beds (at 1,354 ft) which have yielded Aptian foraminifera (N. H. Ludbrook, South Australian Department of Mines Palaeontological Report 14/56, 1956 unpublished). The sample from Penola Bore No. 1 was taken from the Mocamboro Member (Ludbrook 1963b).

The Stylosus Assemblage is characterized diagnostically by the consistently occurring species *Crybelosporites stylosus* sp. nov. in association with the following species that possess limited vertical distribution but which are not exclusive to the assemblage: *Cyclosporites hughesi* (Cookson & Dettmann), *Coronatispora perforata* sp. nov., *Murospora florida* (Balme), *Contignisporites cooksonii* (Balme), *Kraeuselisporites linearis* (Cookson & Dettmann), and *Biretisporites spectabilis* sp. nov.

The most abundant forms present in the assemblage are *Microcachyridites antarcticus* Cookson and *Podocarpidites* cf. *P. ellipticus* Cookson, while the following species occur commonly: *Classopollis* cf. *C. classoides* Pflug, *Spheripollenites psilatus* Couper, *Araucariacites australis* Cookson, *Ginkgocycadophytus nitidus* (Balme), *Alisporites grandis* (Cookson), *Gleicheniidites* cf. *G. cercinidites* (Cookson), *Lycopodiumsporites austroclavatidites* (Cookson), *L. reticulumsporites* (Rouse), *Baculatisporites comaumensis* (Cookson), *Osmundacidites wellmanii* Couper, *Stereisporites antiquasporites* (Wilson & Webster), *Cyathidites australis* Couper, and *C. minor* Couper.

Species which are of rarer occurrence include: *Cyathidites asper* (Bolkhovitina), *C. concavus* (Bolkhovitina), *Foveosporites canalis* Balme, *Foveotriletes parviretus* (Balme), *Reticulatisporites pudens* Balme, *Cicatricosisporites australiensis* (Cookson), *Cingutriletes clavus* (Balme), *Aequitriradites verrucosus* (Cookson & Dettmann), *Tsugaepollenites dampieri* (Balme), and *T. trilobatus* (Balme).

The Stylosus Assemblage is closely comparable to Western Australian Lower Cretaceous microspore assemblages (Mircoflora IIB of Balme 1957). Although the precise age limits of Microflora IIB have not been determined, it was recorded only in Neocomian-Aptian strata. The Western Australian Neocomian-Aptian microflora is characterized diagnostically, and distinguishable from Oxfordian-Kimeridgian assemblages, by an abundance of *Microcuchyridites antarcticus* and rarity of

Tsugaepollenites dampieri, together with species such as *Reticulatisporites pudens, Cicatricosisporites australiensis, Foveotriletes parviretus,* and *Murospora florida.* The Stylosus Assemblage possesses all these characteristics and, further, lacks all the diagnostic components of Western Australian Oxfordian-Kimeridgian assemblages.

One of the constituent species, *Cicatricosisporites autraliensis*, occurs in Lower Cretaceous strata of Queensland and Papua and has not been reported in definite Jurassic strata in Australasia. It is known also from Lower Cretaceous only of India (Vishnu-Mittre 1955, and cf. Arkell 1956, p. 383), Russia (Bolkhovitina 1961), and Canada (Pocock 1962), and in England it occurs in uppermost horizons of the Purbeck (Lantz 1958b).

Cyathidites asper is reported from Berriasian-Aptian deposits of Canada (Pocock 1962), and in the U.S.S.R. it appears to be typically represented in Lower Cretaceous strata (see Bolkhovitina 1961, p. 87).

Aequitriradites verrucosus occurs exclusively in the Cretaceous of Siberia (Bolkhovitina 1959, Samoilovitch et al. 1961, Chlonova 1961).

Horizons immediately succeeding those from which the Stylosus Assemblage has been recovered contain several species which, in other parts of the world, first appear in Valanginian or younger strata.

Thus, from the available evidence it appears that the Stylosus Assemblage is post-Kimeridgian and Valanginian or older in age; the presence of *Cicatriocosisporites australiensis* and *Aequitriradites verrucosus* supports a Lower Cretaceous rather than an Upper Jurassic age.

The Speciosus Assemblage

This assemblage (see Tables 4, 6, and 7) has been identified in samples which immediately succeed those containing the Stylosus Assemblage in Cootabarlow Bore No. 2 and Penola Bore No. 1 and in the lower intervals of Oodnadatta Bore No. 1 and Robe Bore No. 1 as follows: Oodnadatta Bore No. 1 between 642 ft and 1,292 ft; Cootabarlow Bore No. 2 between 1,330 ft and 1,404 ft; Penola Bore No. 1 between 2,990 ft and 4,618 ft; and Robe Bore No. 1 between 3,325 ft and 4,300 ft.

The interval in the Oodnadatta Bore includes horizons of the Blythesdale Group (1,007-1,292 ft) and the Roma Formation (642-1,007 ft) which is Aptian in age (Sprigg in Glaessner and Parkin 1958); more precise age determinations based on the evolutionary series of *Maccoyella* have not yet been published. In Cootabarlow Bore No. 2 the strata intersected between 1,390 ft and 1,404 ft are believed to be within the Blythesdale Group (Condon et al. 1960, Ludbrook 1963a) and the sample from 1,354 ft is dated as Aptian on the basis of foraminifera (N. H. Ludbrook, unpublished). Microplankton assemblages have been reported from 1,052-61 ft in the Oodnadatta Bore and at 1,354 ft in Cootabarlow Bore No. 2 (Cookson and Eisenack 1960b; Eisenack and Cookson 1960); the age evidence presented by these authors is in agreement with the palaeontological findings cited above.

The Penola Bore sediments include probable equivalents of the Mocamboro Member (4,200-4,618 ft) and the Runnymede Formation (2,990-4,200 ft) and the

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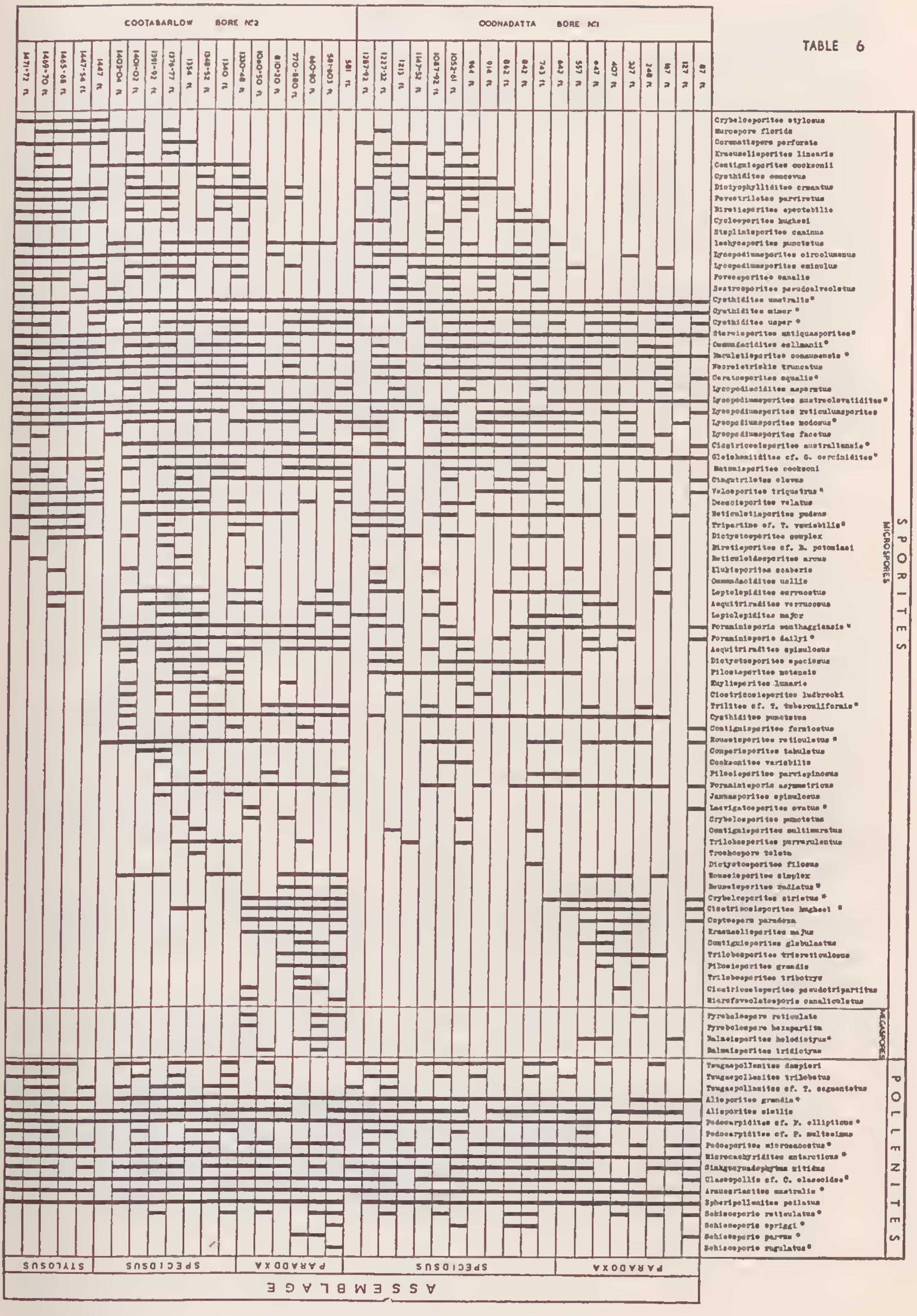
Table 6

*Vertical ranges of spore and pollen species in the Mesozoic sequences in Oodnadatta Bore No. 1 and Cootabarlow Bore No. 2 in the Great Artesian Basin. The species are arranged approximately in stratigraphical order of appearance. Species marked * have been observed in samples (Haddon Downs Bore No. 5 between 452 ft 7 in. and 1,406 ft) of the Winton Formation in the Great Artesian Basin.*

Corrigendum: In the list of species *Trochospora telata* should read *Coronatispora telata.*

TABLE 6


COOTABARLOW BORE No. 2
1471-72 ft
1469-70 ft
1465-68 ft
1447-54 ft
1447 ft
1403-04 ft
1401-02 ft
1391-92 ft
1376-77 ft
1354 ft
1348-52 ft
1340 ft
1330-48 ft
1040-50 ft
810-20 ft
770-880 ft
640-90 ft
597-603 ft
581 ft
OODNADATTA BORE No. 1
1287-92 ft
1227-32 ft
1213 ft
1147-52 ft
1087-92 ft
1052-61 ft
964 ft
914 ft
862 ft
842 ft
743 ft
643 ft
557 ft
447 ft
407 ft
327 ft
248 ft
167 ft
127 ft
87 ft
Crybelosporites stylosus
Murospora florida
Coronatispora perforata
Kraeuselisporites linearis
Contignisporites cooksonii
Cyathidites concavus
Dictyophyllidites crenatus
Foveotriletes parviretus
Biretisporites spectabilis
Cyclosporites hughesi
Staplinisporites caminus
Ischyosporites punctatus
Lycopodiumsporites circolumenus
Lycopodiumsporites eminulus
Foveosporites canalis
Sestrosporites pseudoalveolatus
Cyathidites australis*
Cyathidites minor *
Cyathidites asper *
Stereisporites antiquasporites*
Osmundacidites wellmanii*
Baculatisporites comaumensis *
Neoraistrickia truncatus
Ceratosporites equalis*
Lycopodiacidites asperatus
Lycopodiumsporites austroclavatidites*
Lycopodiumsporites reticulumsporites
Lycopodiumsporites nodosus*
Lycopodiumsporites facetus
Cicatricosisporites australiensis*
Gleicheniidites cf. G. circinidites*
Matonisporites cooksoni
Cingutriletes clavus
Velosporites triquetrus*
Densoisporites velatus
Reticulatisporites pudens
Tripartina cf. T. variabilis*
Dictyotosporites complex
Biretisporites cf. B. potoniaei
Reticuloidosporites arcus
Klukisporites scaberis
Osmundacidites mollis
Leptolepidites verrucatus
Aequitriradites verrucosus
Leptolepidites major
Foraminisporis wonthaggiensis*
Foraminisporis dailyi*
Aequitriradites spinulosus
Dictyotosporites speciosus
Pilosisporites notensis
Kuylisporites lunaris
Cicatricosisporites ludbrooki
Trilites cf. T. tuberculiformis*
Cyathidites punctatus
Contignisporites fornicatus
Rouseisporites reticulatus*
Conperisporites tabulatus
Cooksonites variabilis
Pilosisporites parvispinosus
Foraminisporis asymmetricus
Januasporites spinulosus
Laevigatosporites ovatus*
Crybelosporites punctatus
Contignisporites multimuratus
Trilobosporites purverulentus
Trochospora teleta
Dictyotosporites filosus
Rouseisporites simplex
Rouseisporites radiatus*
Crybelosporites striatus*
Cicatricosisporites hughesi*
Coptospora paradoxa
Kraeuselisporites majus
Contignisporites glebulentus
Trilobosporites trioreticulosus
Pilosisporites grandis
Trilobosporites tribotrys
Cicatricosisporites pseudotripartitus
Microfoveolatosporis canaliculatus
MICROSPORES
Pyrobolospora reticulata
Pyrobolospora hexapartita
Balmeisporites holodictyus*
Balmeisporites tridictyus
MEGASPORES
SPORITES
Tsugaepollenites dampieri
Tsugaepollenites trilobatus
Tsugaepollenites cf. T. segmentatus
Alisporites grandis*
Alisporites similis
Podocarpidites cf. P. ellipticus*
Podocarpidites cf. P. multesimus
Podosporites microsaccatus*
Microcachryidites antarcticus*
Ginkgocycadophytus nitidus
Classopollis cf. C. classoides*
Araucariacites australis*
Spheripollenites psilatus
Schizosporis reticulatus*
Schizosporis spriggi*
Schizosporis parvus*
Schizosporis rugulatus*
POLLENITES
STYLOSUS
SPECIOSUS
PARADOXA
SPECIOSUS
PARADOXA
ASSEMBLAGE

Robe Bore interval includes horizons of the Runnymede Formation (see Ludbrook 1961b, 1963b).

The Speciosus Assemblage is characterized by the presence of *Dictyotosporites speciosus* Cookson & Dettmann and lacks the 'index' species, *Crybelosporites stylosus*, of the Stylosus Assemblage. Also significant is the occurrence of the following species which have not been identified in the older assemblage: *Cicatricosisporites ludbrooki* sp. nov., *C. hughesi* sp. nov., *Pilosisporites notensis* Cookson & Dettmann, *P. parvispinosus* sp. nov., *Kuylisporites lunaris* Cookson & Dettmann, *Foraminisporis wonthaggiensis* (Cookson & Dettmann), *F. asymmetricus* (Cookson & Dettmann), *Rouseisporites reticulatus* Pocock, *R. simplex* (Cookson & Dettmann), *R. radiatus* sp. nov., *Cyathidites punctatus* (Delcourt & Sprumont), *Aequitriradites spinlosus* (Cookson & Dettmann), *Cooksonites variabilis* Pocock, *Schizosporis reticulatus* Cookson & Dettmann, and *Crybelosporites striatus* (Cookson & Dettmann).

Furthermore, the following rare components, some of which occur in the Great Artesian Basin only, are unknown in the Stylosus Assemblage: *Dictyotosporites filosus* sp. nov., *Trilobosporites purverulentus* (Verbitskaya), *Trilites* cf. *T. tuberculiformis* Cookson, *Januasporites spinlosus* sp. nov., *Couperisporites tabulatus* sp. nov., *Contignisporites fornicatus* sp. nov., *C. multimuratus* sp. nov., and *Crybelosporites punctatus* sp. nov.

Species present in significant proportions in both the Stylosus and Speciosus Assemblages include: *Microcachyridites antarcticus, Podocarpidites* spp., *Alisporites* spp., *Classopollis* cf. *C. classoides, Cyathidites australis, C. minor, Stereisporites antiquasporites, Lycopodiumsporites* spp., and *Gleicheniidites* cf. *G. cercinidites.*

The Speciosus Assemblage contains many exclusively Cretaceous species reported previously from Western Australia, Canada, Siberia, Russia, and Europe. These include: *Murospora florida, Reticulatisporites pudens*, and *Foveotriletes parviretus* which, as outlined above, occur in the Lower Cretaceous of Western Australia; and *Cyathidites punctatus* which is unknown from pre-Cretaceous strata in England, Belgium, U.S.S.R., and Canada.

Two species, *Foraminisporis wonthaggiensis* and *Rouseisporites reticulatus,* which first appear in the stratigraphically lower horizons containing the Speciosus Assemblage, have been reported hitherto from Barremian or younger strata of Siberia (Samoilovitch et al. 1961) and Canada (Pocock 1962).

Aequitriradites spinuosus which also occurs in the lower horizons containing the Speciosus Assemblage is known from Hauterivian-Danian only of U.S.S.R. (Bolkhovitina 1959, Samoilovitch et al. 1961) and in Canada first appears in Valanginian strata (Pocock 1962).

Cooksonites variabilis, Schizosporis reticulatus, and *Trilobosporites purverulentus* are known only from Valanginian or younger deposits; the former two species first occur in the Valanginian and Barremian respectively of Canada (Pocock 1962), and the latter species has been reported from Barremian or younger strata of Russia and Siberia (Verbitskaya 1962, Samoilovitch et al. 1961).

Another significant species is *Foraminisporis asymmetricus* which first appears in horizons stratigraphically higher than those containing *F. wonthaggiensis* and

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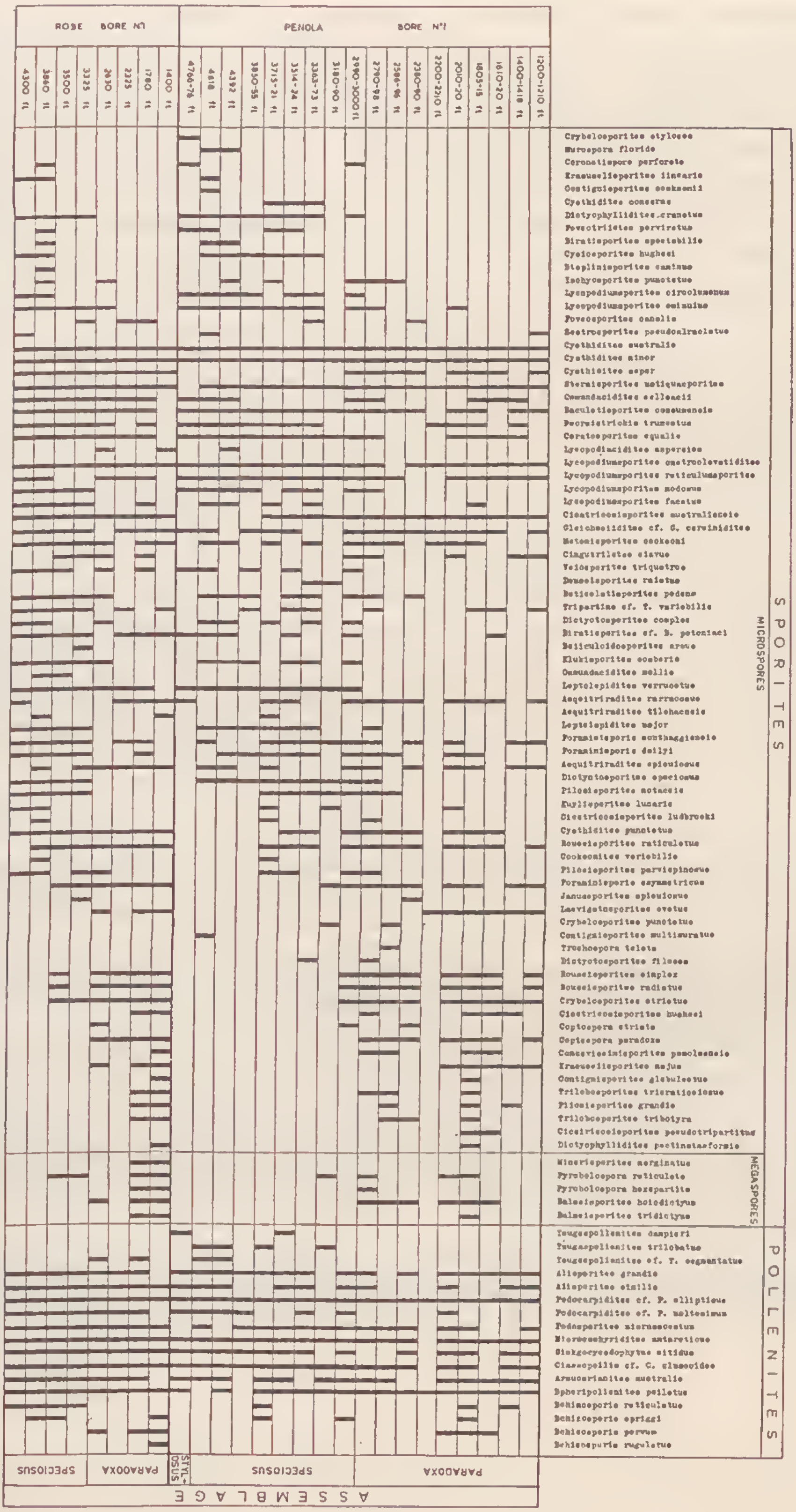
TABLE 7

Vertical ranges of spore and pollen species in the Mesozoic sequences in Penola Bore No. 1 and Robe Bore No. 1 in the Otway Basin. The species are arranged approximately in stratigraphical order of appearance.

Corrigendum: In the list of species *Trochospora telata* should read *Coronatispora telata.*


ROSE BORE No1
PENOLA BORE No1
4300 ft
3860 ft
3500 ft
3325 ft
2930 ft
2325 ft
1780 ft
1400 ft
4766-76 ft
4618 ft
4392 ft
3850-55 ft
3715-21 ft
3514-24 ft
3363-73 ft
3180-90 ft
2990-3000 ft
2790-98 ft
2586-96 ft
2380-90 ft
2200-2210 ft
2010-20 ft
1805-15 ft
1610-20 ft
1400-1418 ft
1200-1210 ft
Crybelosporites stylosus
Nurosporа florida
Coronatispora perforata
Krauselisporites linearis
Contignisporites cooksonii
Cyathidites concavus
Dictyophyllidites crenatus
Foveotriletes parviretus
Biretisporites spectabilis
Cyclosporites hughesi
Stoplinisporites caminus
Ischyosporites punctatus
Lycopodiumsporites circolumenus
Lycopodiumsporites eminulus
Foveosporites canalis
Sestrosporites pseudoalveolatus
Cyathidites australis
Cyathidites minor
Cyathidites asper
Stereisporites antiquasporites
Osmundacidites wellmanii
Baculatisporites comaumensis
Pecrоsistrickia truncatus
Ceratosporites equalis
Lycopodiacidites asperatus
Lycopodiumsporites austroclavatidites
Lycopodiumsporites reticulumsporites
Lycopodiumsporites nodosus
Lycopodiumsporites facetus
Cicatricosisporites australiensis
Gleicheniidites cf. G. circinidites
Matonisporites cooksoni
Cingutriletes clavus
Velosporites triquetrus
Densoisporites velatus
Reticulatisporites pudens
Tripartina cf. T. variabilis
Dictyotosporites complex
Biretisporites cf. B. potoniaei
Sellaginellaceae? Selliculoidosporites aresus
Klukisporites scaberis
Osmundacidites mollis
Leptolepidites verrucatus
Aequitriradites verrucosus
Aequitriradites tilchaensis
Leptolepidites major
Foraminisporis wonthaggiensis
Foraminisporis dailyi
Aequitriradites spinulosus
Dictyotosporites speciosus
Pilosisporites notensis
Kuylisporites lunaris
Cicatricosisporites ludbrooki
Cyathidites punctatus
Rouseisporites reticulatus
Cookosonites variabilis
Pilosisporites parvispinosus
Foraminisporis asymmetricus
Janusporites spiculosus
Laevigatosporites ovatus
Crybelosporites punctatus
Contignisporites multimuratus
Trochosporа telata
Dictyotosporites filosus
Rouseisporites simplex
Rouseisporites radiatus
Crybelosporites striatus
Cicatricosisporites hughesi
Coptospora striata
Coptospora paradoxa
Concavissimisporites penolaensis
Krauselisporites major
Contignisporites glebulentus
Trilobosporites trireticulosus
Pilosisporites grandis
Trilobosporites tribotrys
Cicatricosisporites pseudotripartitus
Dictyophyllidites pectinataeformis
Minerisporites marginatus
Pyrobolospora reticulata
Pyrobolospora hexapartita
Balmeisporites holodictyus
Balmeisporites tridictyus
Tsugaepollenites dampieri
Tsugaepollenites trilobatus
Tsugaepollenites cf. T. segmentatus
Alisporites grandis
Alisporites similis
Podocarpidites cf. P. ellipticus
Podocarpidites cf. P. multesimus
Podosporites microsaccatus
Microcachryidites antarcticus
Ginkgocycadophytus nitidus
Classopollis cf. C. classoides
Araucariacites australis
Sphaeripollenites psilatus
Schizosporis reticulatus
Schizosporis spriggi
Schizosporis parvus
Schizosporis rugulatus
MICROSPORES
MEGASPORES
SPORITES
POLLENITES
SPECIOSUS
PARADOXA
STYLOSUS
SPECIOSUS
PARADOXA
ASSEMBLAGE

Rouseisporites reticulatus and which occurs in Aptian-Albian strata of Russia (Verbitskaya 1962). However, in Canada *F. asymmetricus* apparently enters the Manville formation in the basal (Berriasian) beds of the Deville member (Pocock 1962, p. 22; but see p. 56 and Table 1 where the age range is quoted as 'Barremian to Aptian'). It should be mentioned that the Canadian Deville member and overlying Quartz Sand member have been dated as Berriasian-Valanginian and Barremian respectively on the basis of microfloral correlations with the English Wealden. Pocock (1962, p. 25) considers that 'the junction between the Deville and Quartz Sand members is unconformable' and that the Hauterivian stage is 'completely unrepresented' in the Manville formation.

From the above evidence it is concluded that the Speciosus Assemblage is of a Lower Cretaceous age, certainly no younger than Aptian (on faunal evidence) and probably no older than Valanginian. However, a possible extension into the uppermost Berriasian is not precluded; more detailed accounts of the microfloral succession within Canadian and Siberian Lower Cretaceous strata may provide further evidence for the lower age limit of the Speciosus Assemblage.

FURTHER REMARKS: There is some evidence in all four bore sequences that the Speciosus Assemblage may be subdivided into two microfloral categories. The stratigraphically lower horizons that contain *Dictyotosporites speciosus* have also yielded one or more of the following species, the first four of which occur also in the Stylosus Assemblage: *Murospora florida, Cyclosporites hughesi, Contignisporites cooksonii, Krauselisporites linearis*, and *Cooksonites variabilis*. None of these species is found in the stratigraphically higher beds that contain *Dictyotsporites speciosus* in association with one or more of *Crybelosporites striatus, Rouseisporites radiatus, Coptospora striata* sp. nov., and *Pyrobolspora reticulata* Cookson & Dettmann.

The former assemblage, in containing *D. speciosus* together with *Cyclosporites hughesi*, is equivalent to the 'pre-Albian' spore association which Cookson and Dettmann (1958b, p. 123) identified in the lower horizons (3,860-4,300 ft) in Robe Bore No. 1. This assemblage occurs also in Oodnadatta Bore No. 1 at 743-1,292 ft, Cootabarlow Bore No. 2 at 1,330-1,402 ft, and Penola Bore No. 1 at 3,363-4,618 ft. On faunal and microfloral evidence assemblages containing *D. speciosus* and *C. hughesi* range in age from Valanginian to Aptian.

The younger assemblage which is characterized by *D. speciosus* together with *Crybelosporites striatus* occurs in beds (Penola Bore No. 1 at 2,990-3,000 ft and Robe Bore No. 1 at 3,325-3,500 ft) in which *Pilosisporites notensis* is also present. In the Oodnadatta Bore *C. striatus* first appears (at 642 ft) within the Roma Formation (Aptian), whilst *D. speciosus* and *P. notensis* are unknown from horizons succeeding the Roma Formation. This evidence indicates that assemblages containing *C. striatus, D. speciosus*, and/or *P. notensis* are Aptian in age.

It is important to note, however, that an admixture of the two microfloras occurs in strata from elsewhere in SE. Australia; Cookson and Dettmann (1958b, p. 125) and Dettmann (1959) recorded an 'intermediate' association characterized by the presence of *D. speciosus, Cyclosporites hughesi*, and *Crybelosporites striatus* in Comaum Bore at 708 ft and Woodside Well No. 2 at 6,892 ft. From the evidence cited above, assemblages containing these three species are of an Aptian age.

THE PARADOXA ASSEMBLAGE

This assemblage (see Tables 5, 6 and 7) has been recovered from samples which immedaitely succeed those containing the Speciosus Assemblage as follows: Oodnadatta Bore No. 1 between 87 ft and 557 ft; Cootabarlow Bore No. 2 between 581 ft and 1,050 ft; Penola Bore No. 1 between 1,200 ft and 2,790 ft; and Robe Bore No. 1 between 1,400 ft and 2,630 ft.

The sediments in the Oodnadatta bore interval include horizons of the Roma Formation (435-557 ft) which is Aptian in age and the Tambo Formation (87-435 ft) of Lower-Upper Albian age (Sprigg in Glaessner and Parkin 1958); more precise age determinations based on palaeonotological analyses are not yet available. Eisenack and Cookson (1960) and Cookson and Eisenack (1962) have reported microplankton assemblages from the 307-612 ft interval in the Oodnadatta bore. A similar assemblage was reported earlier (Cookson and Eisenack 1958) from 581-600 ft in Cootabarlow Bore No. 2, and it was correlated with Albian assemblages from the lower part of the Gearle Siltstone, Western Australia (see McWhae et al. 1958). The strata from the Penola and Robe bores are considered to be from the Runnymede Formation (Ludbrook 1961b, 1963b).

This assemblage, which is named from its most consistently occurring diagnostic species, contains the following forms not observed in the older assemblages: *Coptospora paradoxa* (Cookson & Dettmann), *Pilosisporites grandis* sp. nov., *Cicatricosisporites pseudotripartitus* (Bolkhovitina), *Trilobosporites trioreticulosus* Cookson & Dettmann, *T. tribotrys* sp. nov., *Contignisporites glebulentus* sp. nov., *Kraeuselisporites majus* (Cookson & Dettmann), and both *Concavissimisporites penolaensis* sp. nov. and *Dictyophyllidites pectinataeformis* (Bolkhovitina) which were recovered only from the Otway Basin sections.

None of the above species has been observed in samples from the Winton Formation, Great Artesian Basin (see Tables 5 and 6). Moreover, samples containing the Paradoxa Assemblage, with the exception of that from 2,790-98 ft in Penola Bore No. 1, have not yielded the 'index' species of the Speciosus Assemblage.

Several species, which are also components of the Speciosus Assemblage, are often present in significant proportions: *Cicatricosisporites australiensis, C. hughesi, Balmeisporites holodictyus* Cookson & Dettmann, *Crybelosporites striatus, Rouseisporites reticulatus, R. simplex, R. radiatus, Aequitriradites spinulosus, Cyathidites punctatus,* and *Foraminisporis asymmetricus.*

Species usually abundant, as in both the older assemblages, include: *Cyathidites australis, C. minor, Stereisporites antiquasporites, Baculatisporites comaumensis, Gleicheniidites* cf. *G. cerninidites, Alisporites grandis, Podocarpidites* cf. *P. ellipticus, Microcachyridites antarcticus, Araucariacites australis,* and *Spheripollenites psilatus.*

On faunal evidence the Paradoxa Assemblage is Aptian (in part) and Lower-Upper Albian in age, but a possible extension into the Cenomanian is not precluded on the following grounds: the upper levels (87-167 ft) in Oodnadatta Bore No. 1 contain an undescribed angiospermous (tricolpate) species which occurs in the Winton Formation and which first appears in Upper Cretaceous deposits of W. Victoria (unpublished information); two trilete species (*Cicatricosisporites pseudotripartitus* and *Trilobosporites triobotrys*), apparently restricted to the Paradoxa Assemblage, are known only from Cenomanian or younger strata in Siberia (Bolkhovitina 1961, Samoilovitch et al. 1961); and *Dictyophyllidites pectinataeformis* shows a similar vertical restriction in the Moscow Basin, Russia (Bolkhovitina 1953). However, definite pronouncement on the upper age limit of the Paradoxa Assemblage must necessarily await more conclusive palaeontological evidence together with a more detailed palynological investigation of the upper part of the Tambo Formation and the Winton Formation.

Discussion

As outlined above, the Stylosus, Speciosus, and Paradoxa Assemblages are of probable lowermost Cretaceous (Valanginian or older), Valanginian-Aptian, and Aptian-Albian ages respectively. It is relevant to add that the age limits of the Paradoxa Assemblage and the upper age limit of the Speciosus Assemblage shall be known more precisely when details of the faunal succession in the Oodnadatta Bore become available. On microfloral evidence, the lower non-marine horizons of this sequence are probably no older than Valanginian in age. Thus, Oodnadatta Bore No. 1 incorporates Mesozoic strata (of the Blythesdale Group and Roma and Tambo Formations) ranging in age from Valanginian to at least Upper Albian.

All three microfloral assemblages are represented successively in the partly marine Mesozoic section intersected by Cootabarlow Bore No. 2 in the Great Artesian Basin. This bore sequence includes horizons of the Blythesdale Group and Roma and Tambo Formations, and ranges in age from lowermost Cretaceous (Valanginian or older) to Albian.

The three assemblages also occur in non-marine Mesozoic horizons of the Otway Basin. Strata from Penola Bore No. 1, which penetrated the Runnymede Formation and entered the Mocamboro Member, contain all three assemblages and range in age from lowermost Cretaceous (Valanginian or older) to at least Albian. The two younger microfloral assemblages are represented successively in Robe Bore No. 1, indicating that the Runnymede Formation intersected at this locality incorporates horizons ranging in age from Valanginian to at least Albian.

Correlation Within South-Eastern Australia

The microfloras assemblages delineated above have been identified in samples from various other localities in the Great Artesian Basin and the Otway Basin as well as in the Murray Basin, E. Victoria, and central New South Wales. The sediments from these localities may thus be correlated with the reference sequences in the Great Artesian and Otway Basins. The spore and pollen species recorded from localities other than the four reference sections are listed in Tables 8 and 9. Table 8 incorporates samples containing either the Stylosus Assemblage or the Speciosus Assemblage, and Table 9 includes samples in which the Paradoxa Assemblage has been identified. Stratigraphical and precise locality details are listed in Appendix II (see also Fig. 1); the microfloral content of the majority of the samples is briefly considered below.

Great Artesian Basin

1. Oodnadatta Bore No. 2 at 47 ft.

This horizon contains a microflora representative of the Paradoxa Assemblage and in which angiospermous grains have been identified. As such the microflora corresponds to those extracted from the 87-167 ft interval in Oodnadatta Bore No. 1.

Table 8

Check list of spore and pollen species, representative of the Stylosus Assemblage and the Speciosus Assemblage, present in samples additional to those documented in Tables 3 and 4. 'cf' indicates presence of specimens similar to, but not identical with, a particular species.

Corrigendum: In the list of species *T. telata* should read *C. telata*.

Species	Group	New South Wales: Warren Bore No 10528 580 ft	Eastern Victoria: Paradise Creek P22733	Wintour's Creek P22602	Whitelaw P12805	Bengworden South Bore No 3 3037 ft	Jumbunna Bore No 57: 1107 ft	1065 ft	1022 ft	252 ft	230 ft	Outtrim: Bore No 8 3259 ft	Bore No 7 869 ft	Bore No 6 2256 ft	C. Paterson: P22601	P22600	Wonthaggi State Coal Mine Area, Western Area: P22597	P22596	P22595	P22594	No 20 Shaft: P22593	P22592	No 18 Shaft: P22591	P22590	P22589	Kirrak P22598	Kilcunda MUGD 2513	San Remo P22588	Otway Basin: Barrabool Hills P22587	Forrest P16790	Comaum Bore No 2: 708 ft	651 ft	Murray Basin: Loxton Bore 1465-70 ft	1410-15 ft	Great Artesian Basin: Kopperamanna 2970 ft	Eastern Victoria: Kirrak P22599
Cyathidites australis	LAEVIGATI	x	x	x	x	x	x	x	x	x	x	x		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
C. minor	LAEVIGATI	x	x		x	x	x	x		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x
C. punctatus	LAEVIGATI	x																												x			x	x		
C. asper	LAEVIGATI	x				x				x	x				x	x									x		x	x			x					
Stereisporites antiquasporites	LAEVIGATI	x			x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Rirelisporites cf. R. potoniaei	LAEVIGATI			x				x	x							x							x		x											x
R. spectabilis	LAEVIGATI		x																																x	
Dictyophyllidites crenatus	LAEVIGATI		x	x		x		x	x	x					x	x		x	x	x	x	x	x	x	x	x	x	x		x	x				x	x
Leptolepidites verrucatus	APICULATI				x	x	x	x			x	x			x	x		x		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
L. major	APICULATI	x	x	x	x	x							x		x	x		x		x	x				x			x		x	x	x			x	x
Osmundacidites wellmanii	APICULATI		x	x		x																		x						x			x	x	
O. mollis	APICULATI																			x				x				x						x	x
Baculatisporites comaumensis	APICULATI		x		x	x			x	x	x		x	x	x	x	x	x	x			x	x	x	x		x	x	x	x	x	x	x	x	x	
Neoraistrickia truncatus	APICULATI	x	x	x	x	x	x		x	x	x	x	x		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	x	x		x	x
Ceratosporites equalis	APICULATI	x		x		x	x	x	x	x		x	x	x	x	x	x	x	x	x	x	x		x	x	x	x	x	x	x	x	x	x	x	x	x
Pilosisporites notensis	APICULATI					x	x								x	x									x			x	x	x						
P. parvispinosus	APICULATI				x	x																									x		x	x		
Kuylisporites lunaris	APICULATI																							x			x			x		x			
Lycopodiacidites asperatus	MURORNATI			x			x								x								x				x				x	x	x	
Tripartina cf. T. variabilis	MURORNATI			x																							x			x					x
Cyclosporites hughesi	MURORNATI				x										x	x		x			x	x			x	x		x			x				x	x
Foveotriletes parviretus	MURORNATI																																		x	
Foveosporites canalis	MURORNATI														x	x									x			x							x	
Lycopodiumsporites austroclavatidites	MURORNATI	x	x		x	x			x		x	x			x	x	x	x			x	x		x	x	x		x	x	x	x	x	x	x	x	
L. circolumenus	MURORNATI			x	x		x				x			x	x	x					x		x		x			x	x						x	
L. reticulumsporites	MURORNATI	x	x	x	x		x	x			x	x	x	x	x	x		x	x	x	x	x	x	x	x			x	x		x	x	x	x	x	x
L. eminulus	MURORNATI	x		x		x	x	x		x					x	x	x	x	x	x	x	x	x		x	x	x	x	x		x	x			x	x
L. nodosus	MURORNATI	x		x	x	x	x		x			x	x	x	x	x		x	x	x	x	x	x		x	x	x	x	x		x	x	x	x	x	x
L. facetus	MURORNATI	x					x						x	x	x	x									x		x	x	x		x		x		x	x
Reticulatisporites pudens	MURORNATI	x	x		x		x			x		x		x				x	x	x	x	x	x	x	x			x	x		x	x	x	x		x
Klukisporites scaberis	MURORNATI			x	x	x	x			x	x			x	x	x	x	x	x	x	x	x		x	x		x	x	x	x	x		x	x	x	x
Dictyotosporites speciosus	MURORNATI	x	x		x	x	x			x		x		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x		x		
D. complex	MURORNATI	x														x					x				x	x		x	x		x		x		x	x
D. filosus	MURORNATI																											x			x		x			
Cicatricosisporites australiensis	MURORNATI				x	x		x			x				x	x			x						x			x	x	x	x	x	x	x	x	
C. ludbrooki	MURORNATI		x																															x	
C. hughesi	MURORNATI					x																										x	x		
Balmeisporites holodictyus	MURORNATI																													x					x		
Pyrobolospora reticulata	MURORNATI																																	x		
Matonisporites cooksoni	AURICULATI		x													x													x	x	x	x	x	x	x	
Triletes cf. T. tuberculiformis	AURICULATI																																	x		
Ischyosporites punctatus	TRICRASSATI																												x		x	x		x	x	
Gleicheniidites cf. G. circinidites	TRICRASSATI	x																	x	x	x	x	x							x		x	x	x	x	x	
Sestrosporites pseudoalveolatus	TRICRASSATI																																		x	
Coronatispora perforata	TRICRASSATI																																		x	
C. telata	TRICRASSATI															x																			x	
Cingutriletes clavus	CINGULATI																												x		x			x	x	
Murospora florida	CINGULATI		x																															x	
Foraminisporis wonthaggiensis	CINGULATI				x	x					x				x	x									x			x	x	x	x		x	x		
F. dailyi	CINGULATI	x	x		x	x	x				x				x	x					x		x	x	x		x	x	x	x	x	x	x	x	x	
F. asymmetricus	CINGULATI																												x	x	x		x	x		
Contignisporites cooksonii	CINGULATI		x	x																															x	
C. multimuratus	CINGULATI																																		x	
Kraeuselisporites linearis	CINGULATI									x										x				x										
Nimerisporites marginatus	CINGULATI		?																						?						x			x	?	
Crybelosporites stylosus	PERINOTRILITES																																		x	x
C. striatus	PERINOTRILITES																												x	x	x		x	x		
Velosporites triquetrus	PERINOTRILITES															x					x	x	x		x			x			x				x	x
Densoisporites velatus	PERINOTRILITES																																		x	
Cooksonites variabilis	HILATES					x																			x										x	
Aequitriradites verrucosus	HILATES															x																x		x	
A. spinulosus	HILATES					x								x										x		x		x	x	x			x	x	
A. sp.	HILATES																																		x	
Rouseisporites reticulatus	HILATES																												x	x	x		x	x		
R. simplex	HILATES																												x				x	x		
Tsugaepollenites dampieri	SACCITES		x		x																											x	x	
T. trilobatus	SACCITES			x		x																								x				x	
T. cf. T. segmentatus	SACCITES																											x						x	
Alisporites grandis	SACCITES	x	x		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x		x
A. similis	SACCITES		x		x						x				x		x				x	x	x	x	x			x	x		x		x	x	x	x
Podocarpidites cf. P. ellipticus	SACCITES	x	x	x	x	x	x	x	x	x	x	x		x			x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	
P. cf. P. multesimus	SACCITES														x	x	x	x	x		x	x	x	x	x	x					x					x
Podosporites microsaccatus	SACCITES	x			x	x	x	x		x	x	x	x		x	x					x	x	x	x	x	x	x	x		x	x	x	x		x	x
Microcachryidites antarcticus	SACCITES	x	x		x		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Ginkgocycadophytus nitidus	PLICATES		x		x	x	x	x		x	x		x		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x						x	
Classopollis cf. C. classoides	POROSES	x	x	x	x	x	x	x		x	x	x		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Araucariacites australis	ALETES		x	x	x	x				x					x	x	x	x							x			x	x			x	x	x	x	
Spheripollenites psilatus	ALETES				x						x										x			x				x	x	x				
Schizosporis reticulatus	INCERTAE SEDIS																			x				x			x			x		x	x		
S. spriggi	INCERTAE SEDIS		x																													x			
S. parvus	INCERTAE SEDIS																													x					
Assemblage		SPECIOSUS ASSEMBLAGE																																	STYLOSUS ASSEMBLAGE	

OTWAY BASIN				GREAT ARTESIAN BASIN				
BELLARINE PENINSULA P22586	DEVIL'S KITCHEN P22584	BARONGAROOK CREEK P22585	DERGHOLM BORE No 1 532 ft	TILCHA BORE No 2 1040-50 ft	TILCHA BORE No 2 460-80 ft	OODNADATTA BORE No 2 47 ft		
X	X	X	X	X	X	X	Cyathidites australis	LAEVIGATI
X	X	X	X	X	X	X	C. minor	
X			X	X			C. punctatus	
X		X		X	X	X	C. asper	
X	X	X	X	X	X	X	Stereisporites antiquasporites	
			X				Dictyophyllidites crenatus	
X			X				Leptolepidites verrucatus	APICULATI
		X		X	X	X	Osmundacidites wellmanii	
X							O. mollis	
X		X	X	X	X	X	Baculatisporites comaumensis	
X		X	X		X	X	Neoraistrickia truncatus	
X	X	X	X	X	X	X	Ceratosporites equalis	
			X				Pilosisporites notensis	
			X	X			P. parvispinosus	
					X		P. grandis	
			X				Kuylisporites lunaris	
		X			X		Lycopodiacidites asperatus	MURORNATI
			X		X		Tripartina cf. T. variabilis	
			X				Foveotriletes parviretus	
X		X	X		X		Foveosporites canalis	
X	X	X	X	X	X	X	Lycopodiumsporites austroclavatidites	
X			X	X	X	X	L. reticulumsporites	
X				X			L. eminulus	
X			X	X			L. nodosus	
X			X				Reticulatisporites pudens	
	X		X				Klukisporites scaberis	
			X				Januasporites spinulosus	
X	X	X	X	X	X	X	Cicatricosisporites australiensis	
X				X			C. pseudotripartitus	
		X		X	X		C. hughesi	
			X	X	X	X	Balmeisporites holodictyus	
				X	X		B. tridictyus	
					X		Pyrobolospora hexapartita	
			X	X			P. reticulata	
					X		P. nuda	
X	X	X	X		X		Matonisporites cooksoni	AURICULATI
	X	X		X	X	X	Trilobosporites trioreticulosus	
X							Trilites cf. T. tuberculiformis	
			X				Ischyosporites punctatus	
X	X	X	X	X	X	X	Gleicheniidites cf. G. circinidites	TRICRASSATI
		X		X	X	X	Cingutriletes clavus	CINGULATI
		X	X			X	Foraminisporis wonthaggiensis	
X		X	X	X	X	X	F. dailyi	
X	X	X	X	X	X	X	F. asymmetricus	
					X		Contignisporites glebulentus	
					X		C. fornicatus	
				X	X		Kraeuselisporites majus	
			X		X		Minerisporites marginatus	
X	X	X	X	X	X	X	Crybelosporites striatus	PERINO-TRILITES
			X		X		C. punctatus	
				X	X	X	Densoisporites velatus	
			X				Coptospora striata	HILATES
X	X	X	X	X	X	X	C. paradoxa	
			?				Cooksonites variabilis	
			X		X		Aequitriradites verrucosus	
	X		X	X	X		A. spinulosus	
					X		A. tilchaensis	
X	X	X	X	X	X	X	Rouseisporites reticulatus	
X		X	X	X	X		R. simplex	
X		X	X	X			R. radiatus	
X			X	X	X	X	Laevigatosporites ovatus	MONOLETES
					X	X	Microfoveolatosporis canaliculatus	
						X	Tsugaepollenites dampieri	SACCITES
X	X	X	X	X	X	X	Alisporites grandis	
X		X	X	X	X	X	A. similis	
X		X	X	X	X	X	Podocarpidites cf. P. ellipticus	
X			X		X		P. cf. P. multesimus	
X		X	X		X	X	Podosporites microsaccatus	
X		X	X	X	X	X	Microcachryidites antarcticus	
X		X	X		X		Ginkgocycadophytus nitidus	PLICATES
		X	X	X	X	X	Classopollis cf. C. classoides	POROSES
X		X	X	X	X	X	Araucariacites australis	ALETES
X	X	X	X			X	Spheripollenites psilatus	
			X	X	X	X	Schizosporis reticulatus	INCERTAE SEDIS
					X		S. rugulatus	
			X		X		S. spriggi	
					X		S. parvus	

Age: Albian.

2. Kopperamanna Bore at 2,970 ft.

This sample yielded a diverse microflora containing *Crybelosporites stylosus* together with three species, *Cooksonites variabilis, Aequitriradites spinulosus*, and *Cicatricosisporites ludbrooki*, which have not been observed in the Stylosus Assemblage recovered from Cootabarlow Bore No. 2. Other stratigraphically significant species include *Biretisporites spectabilis, Cyclosporites hughesi, Cicatricosisporites australiensis, Contignisporites cooksonii, Murospora florida*, and *Coronatispora perforata*. This association comprises diagnostic elements of both the Speciosus and Stylosus Assemblages, but *Dictyotosporites speciosus* has not been observed in any of the preparations studied by the present writer (cf. Cookson and Dettmann 1958, p. 116). Age: lowermost Cretaceous (Valanginian or older).

3. Tilcha Bore No. 2 at 460-80 ft and 1,040-50 ft.

Both samples, which were studied by Cookson and Dettmann (1958a, b), contain diverse microfloras typical of the Paradoxa Assemblage. Age: Aptian-Albian.

MURRAY BASIN

1. Loxton (Australian Oil and Gas Co. Ltd) bore at 1,410-15 ft and 1,465-70 ft.

Both samples contain *Crybelosporites striatus*, and the stratigraphically higher deposit also contains *Dictyotosporites speciosus*. The presence of these two species together with *Pyrobolspora reticulata, Balmeisporites holodictyus, Cicatricosisporites hughesi* and *Pilosisporites parvispinosus* is indicative of an age older than Albian (cf. Ludbrook 1961b; Cookson and Dettmann 1958a, b) and almost certainly Aptian. The microflora is similar to that obtained from Robe Bore No. 1 at 3,325 ft.

OTWAY BASIN

1. Comaum Bore No. 2 at 651 ft and 708 ft.

The two samples contain well-preserved microfloras in which several diagnostic species of the Speciosus Assemblage have been observed. The sample from 651 ft has yielded both *Dictyotosporites speciosus* and *Crybelosporites striatus*, the presence of which suggests a horizon similar to the 3,325-3,500 ft interval in the Robe Bore and the 2,990-3,000 ft interval in Penola Bore No. 1. The lower horizon at 708 ft also contains *Cyclosporites hughesi*; this association comprises the 'intermediate' microflora of Cookson and Dettmann (1958b). Age: Aptian.

2. Dergholm Bore No. 1 at 532 ft.

A well-preserved microflora representative of the Paradoxa Assemblage is contained in this sample. However, a corroded specimen of *Cooksonites variabilis* was also recovered. Age: Aptian-Albian.

3. Barongarook Creek, sample P22585.

This sample yielded a well-preserved microflora typical of the Paradoxa Assemblage and similar to that contained in the sample studied by Cookson and Dettmann (1958b). Age: Aptian-Albian.

TABLE 9

Check list of spore and pollen species, representative of the Paradoxa Assemblage, present in samples additional to those documented in Table 5. '?' denotes that only doubtful representatives of a species have been observed.

4. Devil's Kitchen, Gellibrand River (sample P22584).

The sample, which was taken from just below the Mesozoic/Palaeocene unconformity, has yielded a sparse microflora referable to the Paradoxa Assemblage. Age: Aptian-Albian.

5. Forrest Bore No. 1, sample 7 (P16770).

The sample yielded a poorly preserved microflora which, in containing *Crybelosporites striatus, Pilosisporites notensis, Foraminisporis asymmetricus, F. wonthaggiensis*, and *Rouseisporites reticulatus*, is probably referable to the Speciosus Assemblage. The occurrence of *Cryebolosporites striatus* together with *Pilosisporites notensis* is indicative of an Aptian age.

6. Bellarine Peninsula, sample P22586.

A well-preserved, prolific microflora representative of the Paradoxa Assemblage was recovered from this sample (see also Cookson and Dettmann 1958a, b). Age: Aptian-Albian.

7. Barrabool Hills, sample P22587.

The presence of the Speciosus Assemblage suggests that the sample was taken from a horizon stratigraphically below the deposit examined by Cookson and Dettmann (1958b). The occurrence of *Pilosisporites notensis* and *Crybelosporites striatus* indicates an Aptian age.

8. Birregurra Bore No. 1 between 1,079 ft and 1,102 ft.

Certain of the species recovered from these horizons are listed by Cookson and Dettmann (1958b, p. 120); these species comprise a microflora referable to the Paradoxa Assemblage. Age: Aptian-Albian.

EASTERN VICTORIA

1. San Remo Peninsula, sample P22588.

A comparatively poorly preserved microflora referable to the Specious Assemblage was recovered from this deposit which was examined by Cookson and Dettmann (1958b). Age: Valanginian-Aptian.

2. Kilcunda, sample M.U.G.D. 2513.

This coal yielded a restricted microflora with species diagnostic of the Speciosus Assemblage. Age: Valanginian-Aptian.

3. Wonthaggi State Coal Mine Area.

Samples P22589 to P22598 inclusive, some of which were examined by Cookson and Dettmann (1958b), all contain the Speciosus Assemblage indicative of a Valanginian-Aptian age.

The coal, P22599, from Kirrak Area yielded *Crybelosporites stylosus*, and is the only Victorian sample in which the Stylosus Assemblage has been identified. Age: lowermost Cretaceous (Valanginian or older).

4. Cape Paterson.

Samples P22600 and P22601 (studied earlier by Cookson and Dettmann 1958b) both contain well-preserved microfloras representative of the Speciosus Assemblage. Species present include *Dictyotosporites speciosus, Cyclosporites hughesi*, and *Pilosisporites notensis*. Age: Valanginian-Aptian.

5. Outtrim.

The highly carbonaceous samples from Bore No. 6, Bore No. 7, and Bore No. 8 have yielded restricted microfloras referable to the Speciosus Assemblage. Age: Valanginian-Aptian.

6. Jumbunna Bore No. 57 between 230 ft and 1,107 ft.

Each of the samples examined contains a poorly-preserved microflora recognizably conformable with the Speciosus Assemblage. Stratigraphically important species include *Dictyotosporites speciosus, Kraeuselisporites linearis,* and *Pilosisporites notensis.* Age: Valanginian-Aptian.

7. Whitelaw Railway Station, sample P12805.

This sample, which was studied by Cookson and Dettmann (1958b), yielded a microflora referable to the Speciosus Assemblage. Age: Valanginian-Aptian.

8. Paradise Creek, Boola Forest; sample P22733.

A prolific, but poorly preserved, microflora referable to the Speciosus Assemblage was obtained from this sample which was collected from near the base of the Tyers Group at Paradise Creek. Stratigraphically important species include *Dictyotosporites speciosus, Murospora florida, Contignisporites cooksonii,* and *Biretisporites spectabilis.* Age: Valanginian-Aptian.

9. Rintoul's Creek, sample P22602.

This outcrop sample of the Tyers Group contains a poorly preserved microflora not certainly identifiable with either the Stylosus or Speciosus Assemblages. *Contignisporites cooksonii* is the only stratigraphically significant species that has been recognized.

Another sample from the Tyers Group (Tyers Bore No. 2 at 860 ft) was studied by Cookson and Dettmann (1958b) and contains the Specious Assemblage indicative of a Valanginian-Aptian age.

10. Bengworden South Bore No. 1 at 3,977 ft.

A well-preserved microflora referable to the Speciosus Assemblage was identified in this horizon from which Cretaceous foraminifera have been reported (Taylor in Webb 1961). Microplanktonic organisms have not been observed in the writer's preparations, and constituent spore species include *Dictyotosporites speciosus, Pilosisporites notensis, Cicatricosisporites hughesi,* and *Cooksonites variabilis.* Age: Valanginian-Aptian.

The following E. Victorian samples, not mentioned above but studied by Cookson and Dettmann (1958b) and Dettmann (1959), contain the Speciosus Assemblage: Korumburra Sunbeam Collieries, shale above coal at 350 ft. Woodside Well No. 2 between 6,402-8,860 ft. Woodside Well No. 3 between 5,711-24 ft. Hedley Well No. 1 between 2,099-2,132 ft. The age of these deposits is considered as Valanginian-Aptian. The sample at 6,892 ft in Woodside Well No. 2 contains *Dictyotosporites speciosus, Cyclosporites hughesi,* and *Crybelosporites striatus* which suggest that the horizons between 6,402 ft and 6,892 ft in this bore are Aptian in age.

E. Victorian deposits in which *Coptospora paradoxa* has been identified include: Woodside Well No. 1 between 5,950-55 ft. Woodside Well No. 2 between 4,114-256 ft. Woodside Well No. 3 at 5,386 ft. The microfloral evidence indicates that these horizons are Aptian-Albian in age.

NEW SOUTH WALES

1. Warren District Bore No. 10528 at 560 ft.

This sample contains a well-preserved but restricted microflora in which the 'index' species of the Stylosus Assemblage has been recognized. Age: Valaginian-Aptian.

From the above it is evident that correlations of Upper Mesozoic strata in SE. Australia (see Table 10) are possible on the sole basis of their contained microfloras. The full stratigraphical significance of the microfloras cannot yet be assessed, but there is some evidence for the belief that they may be used in conjunction with microplankton in the regional correlation of Australian and Papuan Upper Mesozoic sediments. It has already been demonstrated that the Stylosus and Speciosus Assemblages are closely comparable to Western Australian microfloras of Neocomian-Aptian age, and it will be seen from the records presented by Cookson and Dettmann (1958a, b) that the Paradoxa Assemblage is represented in the Albian Styx Coal Measures of Queensland. A number of stratigraphically significant species, which are components of the Speciosus and Paradoxa Assemblages, are also known from Omati, Papua (Cookson and Dettmann loc. cit.).

		ASSEMBLAGE	GREAT ARTESIAN BASIN	OTWAY BASIN		EASTERN VICTORIA		
				GAMBIER SUNKLANDS	PORTLAND SUNKLANDS	WONTHAGGI AREA	TYERS AREA	GIPPSLAND SUNKLANDS
LOWER CRETACEOUS	ALBIAN	PARADOXA	TAMBO FORMATION	RUNNYMEDE	OTWAY			Sediments in
	APTIAN		ROMA	FORMATION	GROUP	? ? ? ?	? ? ? ?	bores
		SPECIOSUS	FORMATION		? ? ? ?	STRZELECKI	TYERS GROUP	
	NEOCOMIAN		BLYTHESDALE	MOCAMBORO		GROUP	? ? ? ?	? ? ? ?
		STYLOSUS	GROUP	MEMBER				

TABLE 10

Correlation of SE. Australian Lower Cretaceous sediments, based on microfloral content.

Some General Conclusions

One of the most notable features of the SE. Australian Cretaceous microfloras is the great variety of types and the large number of Western Australian, Canadian, and Siberian species represented in them. More than 20 of the constituent species of Western Australian Neocomian-Aptian assemblages are components of the Stylosus and Speciosus Assemblages, and all but two of these (*Murospora florida* and *Contignisporites cooksonii*) occur in the Paradoxa Assemblage. The predominance of *Microcachyridites antarcticus, Podocarpidites* spp., *Alisporites* spp., *Glei-*

cheniidites cf. *G. cercinidites*, and *Lycopodiumsporites* spp. and rarity of *Tsugaepollenites* spp. in the Western Australian and SE. Australian Lower Cretaceous microfloras is also noteworthy.

Western Canadian Lower Cretaceous microfloras contain more than 14 of the species represented in the Speciosus and Paradoxa Assemblages. These include saccate (*Podocarpidites* spp., *Tsugaepollenites* spp.), trilete (*Foraminisporis asymmetricus, F. wonthaggiensis, Cicatricosisporites australiensis*), and hilate (*Aequitriradites spinulosus, Rouseisporites reticulatus*) species as well as 'aletc' types referable to *Schizosporis*. One species, *Cooksonites variabilis*, which has restricted vertical distribution in Canada, shows similar stratigraphical restriction in SE. Australia.

W. Siberian Aptian-Albian and Cenomanian microfloral assemblages contain several stratigraphically significant trilete and hilate components of the Speciosus and/or the Paradoxa Assemblage. These include: *Trilobosporites trioreticulosus, T. tribotrys, T. purverulentus, Cicatricosisporites australiensis, C. pseudotripartitus, Aequitriradites spenulosus, A. verrucosus, Rouseisporites reticulatus*, and *Formanisporis wonthaggiensis*.

On the other hand, the SE. Australian Cretaceous microfloras bear little resemblance to those described from New Zealand, Europe, and E. North America. A few elements such as *Cyathidites australis, C. punctatus, Lycopodiumsporites* spp., and *Osmundacidites wellmanii* occur in the microfloras, but these species appear to be of little stratigraphical value within the Lower Cretaceous and show world-wide distribution. It is relevant to add that *Concavissimisporites, Pilosisporites*, and *Trilobosporites* seem to have appeared earlier in British than in Australian deposits. Forms referable to those genera are unknown in the probably lowermost Cretaceous Stylosus Assemblage but occur in Jurassic and lowermost Cretaceous strata of Britain.

The relationships of the spore and pollen species with described megafloral elements contained in SE. Australian Upper Mesozoic strata can only be deduced at present on the basis of spore morphology. The relatively featureless, smooth-walled forms *Cyathidites minor* and *Gleicheniidites* sp. may well have derived from the cyatheaceous or dicksoniaceous species *'Coniopteris hymenophylloides'* and the gleicheneaceous *Microphyllopteris minuta* Medwell respectively. *Osmundacidites wellmanii* and *Baculatisporites comaumensis* are almost certainly a reflection of the osmundaceous elements that are represented in the megaflora. Araucariacean and podocarpaceous elements occur in the megaflora, and their probable derivatives are *Araucariacites* and *Podocarpidites* respectively. Lycopods are well represented by numerous microspore species (*Lycopodiumsporites, Densoisporites, Ceratosporites*, etc.) and are known in the Victorian megaflora. Hepatic species, which have been described in the Barrabool Sandstone megaflora, may have produced some of the hilate forms (*Aequitriradites, Coptospora, Rouseisporites*, etc.) that are often abundantly represented in horizons of the Otway Basin. The widespread occurrence of *Cicatricosisporites* spp. and *Klukisporites scaberis* suggests the presence of schizaeaceous elements in the contemporaneous flora, and the presence of *Crybelosporites* spp. and *Pyrobolospora* spp. may indicate hydropteridean contributions.

APPENDIX I

Note on the Spore Morphology of Two Recent and One Fossil Hepatic Species

Nothylas breutelii Gottsche

(Pl. XXVII, fig. 12-16)

MATERIAL: ex Herb. Hort. Bot. Reg. Kew; coll. C. Wright from Cuba.

TREATMENT: Method of Erdtman (1960); acetolysis followed by chlorination.

DESCRIPTION: Microspores trilete, biconvex; amb subcircular to convexly subtriangular or subquadrangular. Lacsurae straight, extending to periphery. Exine 1·5-2 μ thick, thicker (3-4 μ) equatorially where a narrow, foveolate cingulum is developed. Exine sculptured with either (1) spinulate elements (2-3 μ in basal diameter, 2-4 μ high) distally and reduced spinules proximally, or (2) scattered granules and verrucae (1-6 μ in basal diameter, 1-2 μ high) distally.

DIMENSIONS: (1) Spinulate microspores–equatorial diameter 53 (57) 67 μ; polar diameter 36 (37) 39 μ. (2) Granulate/verrucate microspores–equatorial diameter 45 (51) 56 μ; polar diameter 28 (30) 34 μ.

REMARKS: The two morphologically distinct microspore types which have been recovered from *Nothylas breutelli* Gottsche resemble Australian Mesozoic microspores included within *Foraminisporis* Krutzsch; the spinulate spores (Pl. XXVII, fig. 12-14) are similar in morphology to *F. wonthaggiensis* (Cookson & Dettmann), and the granulate/verrucate forms (Pl. XXVII, fig. 15, 16) resemble *F. dailyi* (Cookson & Dettmann).

Phaeoceros bulbiculosus (Brotero) Prosk.

(Pl. XXVII, fig. 17, 18)

MATERIAL: ex Herb. Hort. Bot. Reg. Kew; coll. Fernandes et al. from Coimbra, Portugal.

TREATMENT: Method of Erdtman (1960); acetolysis only.

DESCRIPTION: Microspores trilete, biconvex; amb subcircular to convexly subtriangular. Laesurae straight, extending to amb, and with slightly elevated lips (2μ wide, 1-2 μ high). Exine scabrate; 1·5-2 μ thick, thicker (3-4 μ) equatorially where a foveolate cingulum is developed. Distal exine thickened in a circular area (15-25μ in diameter) about the pole; thickening foveolate.

DIMENSIONS: Equatorial diameter 48 (60) 67 μ; polar diameter not determined.

REMARKS: The spores resemble *Foraminisporis dailyi* (Cookson & Dettmann), but differ in having a thickened exine about the distal pole and in the absence of distal granules and verrucae.

Naiadita lanceolata Buckman

(Pl. XXVII, fig. 9-11)

MATERIAL: British Museum (Natural History) slides V25309-V25312 inclusive (See Harris, T. M. 1938, p. 45-48; fig. 21, 22; Potonié 1962, p. 36; Pl. 1, fig. 8).

DESCRIPTION: Microspores inaperturate or hilate proximally, rarely with a faint proximal tetrad mark; amb convexly triangular to subcircular. Sclerine two-layered; inner layer scabrate, 2·5-3·5 μ thick; outer layer *c.* 1·5 μ thick, thicker (3-4 μ) equatorially where a narrow cingulum (5-7 μ wide) is developed. Distal and equatorial sclerine verrucate; verrucae 2-3 μ high, 2-3 μ in basal diameter, spaced

2-4 μ apart. Proximal sclerine sculptured with granules and reduced verrucae which are more closely spaced about the pole; an irregular rupture (hilum) as much as 42 μ in diameter is sometimes developed in this area.

DIMENSIONS: Equatorial diameter; overall 78 (100) 111 μ, spore cavity 62 (80) 89 μ. Overall polar diameter (5 specimens) 42 (43) 45 μ.

REMARKS: These fossil spores may be hilate proximally and show some resemblance to *Couperisporites tabulatus* sp. nov., but differ in having a greater development of equatorial thickening and a larger size.

Appendix II

Data on Samples Studied

Outcrop and bore (core, cutting, and sludge) samples are listed and described macroscopically under headings of localities from which they were collected; relevant stratigraphical data are noted. Robe Bore No. 1 samples are lodged in the South Australian Museum, and the Mines Department of South Australia holds material of all other South Australian material examined. Unless otherwise indicated, samples taken from bores put down by the Victorian Department of Mines are lodged with that department. Samples that have been allocated registered numbers prefixed 'P' and 'MUGD' are deposited in the collections of the National Museum of Victoria and the Melbourne University Geology Department respectively. Preparation numbers of each sample are stated—those prefixed 'ICC' were prepared by Dr I. C. Cookson; 'D' indicates preparation by the writer.

GREAT ARTESIAN BASIN (SOUTH AUSTRALIAN PORTION)

1. Oodnadatta Bore No. 1, sunk by South Australian-Northern Territory Oil Search Ltd (Santos). Core and sludge samples comprise:

Depth (ft)	Core/ sludge	Rock type	Stratigraphical unit	Age if previously assessed on marine faunal evidence	Preparation
87	core	greenish-grey mudstone	Tambo Formation	Middle and Upper Albian (Sprigg in Glaessner and Parkin 1958, Brunnschweiler 1959)	D362
127	,,	,, ,,	,, ,,	,, ,,	D387
167	,,	greenish-grey micaceous siltstone	,, ,,	,, ,,	D386
248	,,	grey mudstone	,, ,,	,, ,,	D383
327	,,	,, ,,	,, ,,	,, ,,	D354
407	,,	dark grey mudstone, calcareous	,, ,,	,, ,,	D379, D391
447	,,	greenish-grey mudstone	Roma Formation	Aptian (Sprigg in Glaessner and Parkin 1958, Brunnschweiler 1959)	D378, D390
557	,,	grey mudstone	,, ,,	,, ,,	D377, D389
642	,,	,, ,,	,, ,,	,, ,,	D376, D388
743	,,	grey-micaceous siltstone	,, ,,	,, ,,	D355
842	,,	grey, laminated mudstone	,, ,,	,, ,, ,, ,,	D356
862	,,	grey mudstone	,, ,,	,, ,,	D382
914	,,	dark grey mudstone	,, ,,	,, ,,	D381
964	,,	,, ,,	,, ,,	,, ,,	D380
1,052-61	sludge	grey mudstone	Blythesdale Group		D357
1,087-92	,,	,, ,,	,, ,,		D385
1,147-52	,,	,, ,,	,, ,,		D384
1,213	core	,, ,,	,, ,,		D231, D235, D282
1,227-32	sludge	sand with grey shale	,, ,,		D238, D281
1,287-92	,,	,, ,,	,, ,,		D237

2. Oodnadatta Bore No. 2, sunk by Santos Ltd, at 47 ft. Core sample; dark grey mudstone, Tambo Formation; Middle and Upper Albian; D363.
3. Kopperamanna Bore, 60 miles E. of Lake Eyre, at 2,970 ft. Grey shale, Blythesdale Group (Sprigg in Glaessner and Parkin 1958); D230, D234, D241.

4. Haddon Downs Bore No. 5, NE. South Australia. Core samples examined include:

Depth	Rock type	Stratigraphical unit	Preparation
452 ft 7 in.	grey siltstone	Winton Formation	D360
465 ft	grey shale	,, ,,	D351, D359
801 ft 8 in.	dull coal	,, ,,	D352, D374
1,406 ft	grey mudstone	,, ,,	D353, D361

5. Tilcha Bore No. 2, E. of Lake Callabonna. Sludge samples from:
   (a) 460-80 ft, grey siltstone; D218, D222.
   (b) 1,040-50 ft, grey mudstone; D371.

6. Cootabarlow Bore No. 2, SE. of Lake Callabonna. Core and sludge samples examined comprise:

Depth (ft)	Core/ sludge	Rock type	Stratigraphical unit	Age if previously assessed on marine faunal evidence	Preparation
581	core	lignitic clay	Tambo Formation		D368
581-603	,,	lignitic mudstone	,, ,,		D327, D333
660-80	sludge	carbonaceous mudstone and sand	,, ,,		D244
770-880	,,	glauconitic clay	Roma Formation		D243
810-20	,,	dark grey mudstone	,, ,,		D369
1,040-50	core	brownish sandstone, fine-grained	,, ,,		D324, D332
1,330-48	,,	,, ,,	,, ,,		D303, D338
1,340	,,	,, ,,	,, ,,		D290
1,348-52	,,	grey mudstone	,, ,,		D331
1,354	,,	,, ,,	,, ,,	Aptian (Ludbrook, unpublished)	D228, D232, D242, D274
1,376-77	,,	,, ,,	,, ,,		D289
1,391-92	,,	grey sandstone, fine-grained	Blythesdale Group		D288
1,401-02	,,	grey mudstone	,, ,,		D334
1,403-04	,,	grey sandstone with thin carbonaceous bands	,, ,,		D329
1,427-47	,,	grey sandstone	,, ,,		D297, D306
1,447	,,	grey shale	,, ,,		D328
1,447-64	,,	grey sandstone, fine-grained	,, ,,		D296, D305
1,465-68	,,	,, ,,	,, ,,		D229, D233, D243, D275
1,468-70	,,	brownish sandstone, fine-grained	,, ,,		D302, D336
1,471-72	,,	,, ,,			D304, D337

MURRAY BASIN

SOUTH AUSTRALIA

1. Loxton Bore, sunk by Australian Oil and Gas Co. Ltd, Sec. 6B, Hundred of Bookpurnong (see Ludbrook 1961b). Sludge samples from:
   (a) 1,410-15 ft, greenish-grey mudstone; D364.
   (b) 1,465-70 ft, greenish-grey siltstone; D365.

OTWAY BASIN (GAMBIER SUNKLANDS AND PORTLAND SUNKLANDS)

SOUTH AUSTRALIA

1. Robe Bore No. 1, sunk by South Australian Oil Wells, Sec. 714, Hundred of Waterhouse (see Ludbrook 1961b). Labelled specimens (cuttings) examined comprise:

Depth (ft)	Rock type	Stratigraphical Unit	Preparation
1,400	grey mudstone	Runnymede Formation	D217, D224, D257, ICC60/4
1,780	greenish-grey, micaceous siltstone	,, ,,	D247, D258, D339
2,325	grey mudstone	,, ,,	D246, D256
2,630	grey, laminated siltstone	,, ,,	D225, D259
3,325	greenish-grey, sandy siltstone	,, ,,	D245, D263, D280
3,500	greenish-grey, laminated siltstone; highly carbonaceous	,, ,,	D244, D261
3,860	grey mudstone with fragments of *Unio* sp.	,, ,,	D226
4,300	dark grey, carbonaceous mudstone	,, ,,	D227

2. Penola Bore No. 1, sunk by Oil Development No Liability, Hundred of Penola. Core and cutting samples examined include:

Depth (ft)	Core/ cutting	Rock type	Stratigraphical Unit	Preparation
1,200-210	core	grey, laminated, carbonaceous siltstone	Runnymede Formation, Upper Member	D273
1,400-410	,,	greenish-grey, micaceous siltstone	,, ,,	D285, D301
1,610-20	,,	,, ,,	,, ,,	D283, D295
1,805-15	,,	grey, sandy siltstone	,, ,,	D286, D294
2,010-20	,,	,, ,,	,, ,,	D287, D293
2,200-210	,,	greenish-grey mudstone	,, ,,	D284, D292
2,380-90	,,	greenish-grey siltstone	,, ,,	D272
2,586-96	,,	dark grey, carbonaceous mudstone	,, ,,	D343
2,790-98	,,	dark grey mudstone	,, ,,	D346
2,990-3,000	,,	grey, micaceous siltstone	,, ,,	D345, D349
3,180-90	,,	grey sandstone	,, ,,	D342
3,363-73	,,	grey mudstone	,, ,,	D341
3,514-24	,,	,, ,,	Runnymede Formation, Lower Member	D340
3,715-21	,,	grey, laminated sandstone	,, ,,	D344, D348
3,850-55	cutting	coal	,, ,,	D276
4,392	core	grey mudstone with coalified plant remains	Mocamboro Member	D392
4,618	,,	grey carbonaceous siltstone	,, ,,	D394
4,766-76	,,	pale grey sandstone with carbonaceous matter	,, ,,	D393

3. Comaum Bore No. 2, sunk by South Australian Department of Mines, Hundred of Comaum (see Ludbrook 1961b). Core samples of the Runnymede Formation from:
   (a) 651 ft, grey mudstone; D367.
   (b) 708 ft, grey siltstone; D248, D262.

VICTORIA

1. Dergholm Bore No. 1, sunk by Victorian Department of Mines, Parish of Dergholm. Earth socket sample from 532 ft; brownish-grey mudstone; D210, D216, D299, ICC60/1.
2. Devil's Kitchen, 3½ miles SE. of mouth of Gellibrand River. Outcrop sample; grey mudstone from below Mesozoic/Palaeocene unconformity, Otway Group; coll. G. Baker, P22584; D219, D223.
3. Barongarook Creek, W. branch, 3 miles SE. of Colac. Outcrop sample; brownish siltstone with plant fragments, Otway Group; coll. E. D. Gill, P22585; D203.
4. Forrest Bore No. 1, sunk by Victorian Department of Mines. Core sample 7; dark grey mudstone containing *Velesunio* sp., Otway Group; P16770; D165.
5. Parish of Bellarine. Grey mudstone probably from No. 2 shaft marked on Q.S. 23 SE.; P22586; D163.
6. Barrabool Hills. Grey mudstone from carbonaceous conglomerate outcrop along Barwon River, Barrabool Sandstone; P22587; D249.

EASTERN VICTORIA

1. San Remo Peninsula. Outcrop sample; dark grey mudstone containing *Sphenopteris hispoli* Oldham & Morris from above coal measures; Strzelecki Group; P22588; D145, D150.
2. Kilcunda. Dull coal from outcrop on beach, Strzelecki Group; MUGD 2513; D134.
3. Wonthaggi State Coal Mine Area.
   (a) Grey shale, from an unspecified locality, containing '*Coniopteris hymenophylloides*' Brongn., Strzelecki Group; P22589; D239, D240.
   (b) No. 18 shaft. Banded coal, Strzelecki Group; coll. A. B. Edwards, P22590; D143, D278.
   (c) No. 18 shaft, Bore No. 2 at base of pillar. Coal, Strzelecki Group; coll. A. B. Edwards, P22591; D193.
   (d) No. 20 shaft, bottom seam, 1 E. (SE. dip). Blue coal, Strzelecki Group; coll. A. B. Edwards, P22592; D140.
   (e) No. 20 shaft, bottom seam, 1 E. (SE. dip). Splint and blue coal, Strzelecki Group; coll. A. B. Edwards, P22593; D141.
   (f) Western Area, top seam (W. dip). Coal, Strzelecki Group; P22594; D170.
   (g) Western Area, bottom seam (W. dip). Coal, Strzelecki Group; P22595; D171.
   (h) Western Area, top seam (E. workings). Coal, Strzelecki Group P22596; D142, D277.
   (i) Western Area, Bore No. ? at 100-140 ft. Coal, Strzelecki Group; P22597; D138.
   (j) Kirrak Area, W. heading (2). Coal. Strzelecki Group; coll. A. M. S. Ketch, P22598; D137.
   (k) Kirrak Area, W. heading (41^2). Coal, Strzelecki Group; coll. A. M. S. Ketch, P22599; D139.
4. Cape Paterson.
   (a) Shore platform near Petrel Rock, between Inverloch and Cape Paterson. Outcrop sample; grey mudstone, Strzelecki Group; coll. A. Baker, P22600; D146, D149.
   (b) Shore platform E. of dyke marked on Q.S. 76 SW., W. of Inverloch. Outcrop sample; grey laminated siltstone with plant fragments, Strzelecki Group; coll. E. D. Gill, P22601; D162.
5. Parish of Outtrim.
   (a) Bore No. 6, sunk by Victorian Department of Mines, at 225·6 ft. Core sample; coal, Strzelecki Group; D309.
   (b) Bore No. 7, sunk by Victorian Department of Mines, at 669·9 ft. Core sample; coaly shale, Strzelecki Group; D310.
   (c) Bore No. 8, sunk by Victorian Department of Mines, at 325·9 ft. Core sample; coaly shale, Strzelecki Group; D311.

6. Parish of Jumbunna E. Bore No. 57, sunk by Victorian Department of Mines. Core samples examined include:

Depth (ft)	Rock type	Stratigraphical unit	Preparation
230	coal	Strzelecki Group	D269
252	coaly shale	" "	D271
1,022	coal	" "	D279
1,065	coaly shalc	" "	D270
1,107	" "	" "	D268

7. Whitelaw Railway Station. Outcrop sample; shale containing *Brachyphyllum gippslandicum* McCoy, Strzelecki Group (see Medwell 1954b); P12805; D176.
8. Paradise Creek, Boola Forest. Outcrop sample; highly carbonaceous slate from near base of Tyers Group; coll. J. Douglas, P22733; D397.
9. Rintoul's Creek, N. of Traralgon. Outcrop sample; coal from lowest seam, Tyers Group (see Philip 1958); coll. G. M. Philip, P22602; D316.
10. Parish of Bengworden South. Bore No. 1, sunk by commission of Commonwealth and Victorian Governments near W. shore of Lake Victoria, at 3,977 ft. Core sample; grey mudstone (see Crespin 1941, Webb 1961); Victorian Department of Mines No. 44627; D315.

New South Wales

1. County Gregory, Warren District; Portion 6, Parish Nina; Bore No. 10528 at 560 ft. Coal; P22603; D319.

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Explanation of Plates

Plate I

All figures × 500 unless otherwise specified; from unretouched negatives.

Fig. 1-3—*Cyathidites australis* Couper. 1, Proximal focus; Robe Bore No. 1 at 4,300 ft, D227b/2 49·2 127·5 (P21960). 2, Distal focus; Robe Bore No. 1 at 3,860 ft, D226/1 54·9 121·3 (P21961). 3, Proximal focus of corroded specimen; Wonthaggi, sample P22589, D239/2 39·3 119·8 (P21962).

Fig. 4, 5—*Cyathidites minor* Couper. 4, distal view; Tilcha Bore No. 2 at 460-80 ft, D218/1 40·6 127·0 (P21963). 5, Proximal focus, Wonthaggi No. 20 shaft, sample P22593, D141/1 55·6 127·9 (P21964).

Fig. 6-9—*Cyathidites punctatus* (Delcourt & Sprumont). 6, 7, Proximal and distal foci; Penola Bore No. 1 at 1,805-15 ft, D294/1 29·9 110·2 (P21965). 8, Optical section of specimen showing 'lips' at margins of one laesura; Penola Bore No. 1 at 1,805-15 ft, D286/2 54·9 127·1 (P21966). 9, Proximal view of corroded specimen; Robe Bore No. 1 at 1,400 ft, D217/9 35·5 119·3 (P21967).

Fig. 10-16—*Cyathidites asper* (Bolkhovitina). 10, 11, Proximal and sectional foci; Penola Bore No. 1 at 1,805-15 ft, D286/2 54·7 110·0 (P21966). 12, 13, Sectional and distal foci; Penola Bore No. 1 at 1,610-20 ft, D295/1 55·5 108·7 (P21968). 14, Corroded specimen, proximal view; Robe Bore No. 1 at 1,400 ft, D224/1 33·7 112·2 (P21969). 15, lateral view; Penola Bore No. 1 at 1,610-20 ft, D295/2 35·0 120·8 (P21970). 16, Section showing one-layered exine which is weakly thickened at laesurate margins; Robe Bore No. 1 at 1,400 ft, D217/S58b/1 27·2 117·3 (P21971).

Fig. 17-19—*Cyathidites concavus* (Bolkhovitina). 17, Distal focus; Cootabarlow Bore No. 2 at 1,330-48 ft, D338/1 34·9 123·8 (P21972). 18, 19, Proximal and sectional foci; Cootabarlow Bore No. 2 at 1,469-70 ft, D302/9 33·8 116·7 (P21973).

Fig. 20, 21—*Stereisporites antiquasporites* (Wilson & Webster). 20, × 750 showing distal polar and equatorial radial thickenings; Cape Paterson, sample P22600, D146/1 57·8 115·2 (P21974). 21, Proximal view × 750; Robe Bore No. 1 at 3,325 ft, D245/2 48·9 123·8 (P21975).

Plate II

All figures × 500 and from unretouched negatives

Fig. 1, 2—*Biretisporites* cf. *B. potoniaei* Delcourt & Sprumont. Proximal and distal foci; Robe Bore No. 1 at 1,780 ft, D339/1 47·0 110·2 (P21976).

Fig. 3, 4—*Biretisporites spectabilis* sp. nov. Holotype; proximal surface, high and low foci. Cootabarlow Bore No. 2 at 1,376-77 ft, D289/3 46·5 123·8 (P21977).

Fig. 5-8—*Biretisporites spectabilis* sp. nov. 5, Proximal view; Kopperamanna Bore at 2,970 ft, D241/1 47·3 121·3 (P21978). 6, Lateral view; Cootabarlow Bore No. 2 at 1,376-77 ft, D289/35 22·1 110·0 (P21979). 7, 8, Sections showing one-layered exine which forms the elevated laesurate lips; Cootabarlow Bore No. 2 at 1,376-77 ft, D289/S69/1-2 55·3 124·0 and 46·0 123·0 (P21980).

Fig. 9-12—*Dictyophyllidites pectinataeformis* (Bolkhovitina). 9, Proximal view showing thickened laesurate margins and membraneous lips; Penola Bore No. 1 at 1,805-15 ft, D286/2 57·4 125·0 (P21966). 10-12, Proximal, sectional, and distal foci; Robe Bore No. 1 at 1,400 ft, D224/1 22·6 116·6 (P21969).

Plate III

All figures × 500 unless otherwise specified; from unretouched negatives.

Fig. 1, 2—*Dictyophyllidites crenatus* sp. nov. Holotype, proximal and sectional foci. Cootabarlow Bore No. 2 at 1,469-70 ft, D302/17 38·0 119·4 (P21981).

Fig. 3-5—*Dictyophyllidites crenatus* sp. nov. 3, Proximal view; Penola Bore No. 1 at 3,850-55 ft, D276/2 32·5 120·0 (P21982). 4, Deviating spore showing four laesurae; Robe Bore No. 1 at 4,300 ft, D227b/2 55·5 115·4 (P21960). 5, Lateral view showing membraneous lips; Robe Bore No. 1 at 4,300 ft, D227a/1 36·3 124·2 (P21983).

Fig. 6-9—*Leptolepidites verrucatus* Couper. 6, 7, Proximal views (7, × 1,000); Wonthaggi, Kirrak Area, sample P22599, D139/1 56·5 127·5 (P21984). 8, 9, Proximal and distal foci; Cootabarlow Bore No. 2 at 1,376-77 ft, D289/2 24·8 116·6 (P21985).

Fig. 10-12—*Leptolepidites major* Couper. 10, Distal view; Cape Paterson, sample P22600, D146/2 52·2 127·9 (P21986). 11, 12, Proximal views (12, × 1,000); Wonthaggi, Kirrak Area, sample P22599, D139/2 53·3 115·4 (P21987).

Fig. 13-15—*Concavissimisporites penolaensis* sp. nov. Holotype, proximal, sectional, and distal foci. Penola Bore No. 1 at 1,610-20 ft, D295/1 54·9 108·9 (P21968).

Fig. 16—*Concavissimisporites penolaensis* sp. nov. Distal focus; Robe Bore No. 1 at 1,400 ft, ICC60/4 40·7 119·0 (P21988).

Fig. 17, 18—*Osmundacidites mollis* (Cookson & Dettmann). Lateral views, high and sectional foci; Barrabool Hills, sample P22587, D249/2 49·1 111·9 (P21989).

Fig. 19-21—*Osmundacidites wellmanii* Couper. 19, Proximal view of specimen showing coalescent granules; Koppcramanna Bore at 2,970 ft, D241/3 44·4 122·3 (P21990). 20, Optical section of a more finely sculptured specimen; Cootabarlow Bore No. 2 at 1,340 ft, D290/1 45·7 126·0 (P21991). 21, Proximal view showing granulate margins of laesurae; Penola Bore No. 1 at 1,805-15 ft, D294/1 53·4 121·9 (P21965).

Fig. 22, 23—*Baculatisporites comaumensis* (Cookson). Proximal and sectional foci; Barongarook Creek, sample P22585, D203/1 43·5 109·9 (P21992).

Plate IV

All figures × 500 unless otherwise specified; from unretouched negatives.

Fig. 1-5—*Pilosisporites notensis* Cookson & Dettmann. 1, Proximal view; Robe Bore No. 1 at 4,300 ft. D227b/2 54·1 111·8 (P21960). 2, Lateral view; Cootabarlow Bore No. 2 at 1,354 ft, D242/4 51·8 126·5 (P21993). 3, Proximal focus of deviating specimen; Penola Bore No. 1 at 3,715-21 ft, D344/1 29·2 123·4 (P21994). 4, 5, Sections of a specimen from Robe Bore No. 1 at 3,860 ft; 4, D226/S70a/1-2 43·3 120·3 (P21995); 5, × 1,000, D226/S70a/3 54·6 126·9 (P21996).

Fig. 6, 7—*Pilosisporites parvispinosus* sp. nov. Holotype, proximal and distal foci. Comaum Bore No. 2 at 708 ft, D248/1 26·8 116·3 (P21997).

Fig. 8—*Pilosisporites parvispinosus* sp. nov. Proximal view of specimen figured by Cookson and Dettmann 1958b (Pl. 15, fig. 2); Robe Bore No. 1 at 3,860 ft, Cookson and Dettmann's slide B27 35·8 111·1 (P21998).

Plate V

All figures × 500 unless otherwise specified; from unretouched negatives.

Fig. 1, 2—*Pilosisporites grandis* sp. nov. Holotype, proximal and distal foci. Pretty Hill Bore No. 1 at 2,928-40 ft; ICC/1 41·3 111·8 (P22098).

Fig. 3—*Pilosisporites grandis* sp. nov. Sectional focus; Cootabarlow Bore No. 2 at 770-880 ft, D325/3 37·3 117·1 (P22000).

Fig. 4, 5—*Neoraistrickia truncatus* (Cookson). Proximal and sectional foci; Penola Bore No. 1 at 3,514-24 ft, D340/2 49·2 117·7 (P22001).

Fig. 6-8—*Ceratosporites equalis* Cookson & Dettmann. 6, Optical section; Cootabarlow Bore No. 2 at 1,469-70 ft, D302/1 32·1 126·9 (P22002). 7, Distal view; Cootabarlow Bore No. 2 at 1,354 ft, D242/2 34·2 117·1 (P22003). 8, Lateral view; Wonthaggi, Kirrak Area, sample P22599, D139/2 29·0 115·2 (P21987).

Fig. 9-12—*Kuylisporites lunaris* Cookson & Dettmann. 9, Proximal focus × 750; Cootabarlow Bore No. 2 at 1,340 ft, D290/1 42·9 115·9 (P21991). 10, 11, Proximal and distal foci; Cootabarlow Bore No. 2 at 1,376-77 ft, D289/34 43·8 114·3 (P22004). 12, Distal surface × 1,000 showing microreticulate surface pattern and detail of scutula; Penola Bore No. 1 at 2,010-20 ft, D293/2 39·8 118·3 (P22005).

Fig. 13-15—*Tripartina* cf. *T. variabilis* Maljavikina. 13, Distal focus; Oodnadatta Bore No. 1 at 1,287-92 ft, D237/1 36·7 117·3 (P22006). 14, 15, Proximal focus (15, × 1,000); San Remo, sample P22588, D145/1 54·5 128·8 (P22007).

Plate VI

All figures × 500 unless otherwise specified; from unretouched negatives.

Fig. 1, 2—*Lycopodiacidites asperatus* sp. nov. Holotype; Proximal surface, high and low foci. Koppcramanna Bore at 2,970 ft, D241/4 36·5 118·3 (P22008).

Fig. 3—*Lycopodiacidites asperatus* sp. nov. Distal focus; Kopperamanna Bore at 2,970 ft, D234/10 34·3 120·4 (P22009).

Fig. 4-7—*Cyclosporites hughesi* (Cookson & Dettmann). 4, Proximal surface; Cape Paterson, sample P22601, D162/2 35·0 118·4 (P22010). 5, Distal surface; Robe Bore No. 1 at 3,860 ft, D226/6 38·8 118·7 (P22011). 6, 7, × 1,000 showing proximal muri in surface view and optical section; Cape Paterson, sample P22600, D146/2 46·4 116·2 (P21986).

Fig. 8-13—*Foveotriletes parviretus* (Balme). 8-12, Specimen from Cootabarlow Bore No. 2 at 1,469-70 ft, D302/7 29·0 121·4 (P22012); 8, 9, proximal and distal foci; 10-12, × 1,000 optical section and surface views (high and low foci) of exine. 13, Distal surface of specimen having smaller foveolae; Cootabarlow Bore No. 2 at 1,447-64 ft, D296/2 52·9 111·4 (P22013).

Fig. 14-17—*Foveosporites canalis* Balme. 14, 15, Proximal and distal foci; San Remo, sample P22588, D145/1 50·1 127·3 (P22007). 16, 17, Proximal views (17, × 1,000); Cape Paterson, sample P22600, D149/2 41·8 112·2 (P22014).

Fig. 18-21—*Lycopodiumsporites austroclavatidites* (Cookson). 18, Proximal surface; Robe Bore No. 1 at 1,780 ft, D247/1 47·4 121·0 (P22015). 19-21, Specimens from Barongarook Creek, sample P22585; 19, 20, distal and lateral views, D203/1 58·9 109·8 and 54·2 110·1 respectively (P21992); 21, × 1,000 showing distal reticulum D203/2 40·8 114·1 (P22016).

Plate VII

All figures × 500 unless otherwise specified; from unretouched negatives.

Fig. 1-3—*Lycopodiumsporites circolumenus* Cookson & Dettmann. 1, 2, Proximal and distal foci; Kopperamanna Bore at 2,970 ft, D241/1 29·7 124·2 (P21978). 3, × 1,000 showing portion of distal reticulum; Oodnadatta Bore No. 1 at 1,213 ft, D235/3 39·6 111·5 (P22017).

Fig. 4-7—*Lycopodiumsporites reticulumsporites* (Rouse). 4, 5, Proximal views (5, × 1,000); Wonthaggi, Kirrak Area, sample P22599, D139/2 39·9 124·3 (P21987). 6, 7, Proximal and distal foci; Penola Bore No. 1 at 3,850-55 ft, D276/1 48·0 123·3 (P22018).

Fig. 8-10—*Lycopodiumsporites eminulus* sp. nov. 8, 9, Proximal and distal foci; Penola Bore No. 1 at 3,850-55 ft, D276/2 56·4 123·4 (P21982). 10, Lateral view; Cape Paterson, sample P22601, D162/1 58·2 113·2 (P22019).

Fig. 11, 12—*Lycopodiumsporites eminulus* sp. nov. Holotype. Distal views (12, × 1,000); Wonthaggi, No. 20 shaft, sample P22593, D141/1 38·9 121·4 (P21964).

Fig. 13, 14—*Lycopodiumsporites nodosus* sp. nov. Holotype. Proximal and distal foci. Penola Bore No. 1 at 3,850-55 ft, D276/1 26·9 118·7 (P22018).

Fig. 15, 16—*Lycopodiumsporites nodosus* sp. nov. 15, Portion of distal surface, × 1,000, showing reticulum and granules; Wonthaggi, Kirrak Area, sample P22598, D137/1 23·5 116·6 (P22020). 16, Optical section of muri × 1,000; Robe Bore No. 1 at 3,860 ft, D226/1 49·3 117·9 (P21961).

Fig. 17-20—*Lycopodiumsporites facetus* sp. nov. Holotype. 17, 18, Proximal and distal foci; 19, 20, high and sectional foci of proximal reticulum × 1,000. Wonthaggi, Kirrak Area, sample P22599, D139/2 34·6 110·2 (P21987).

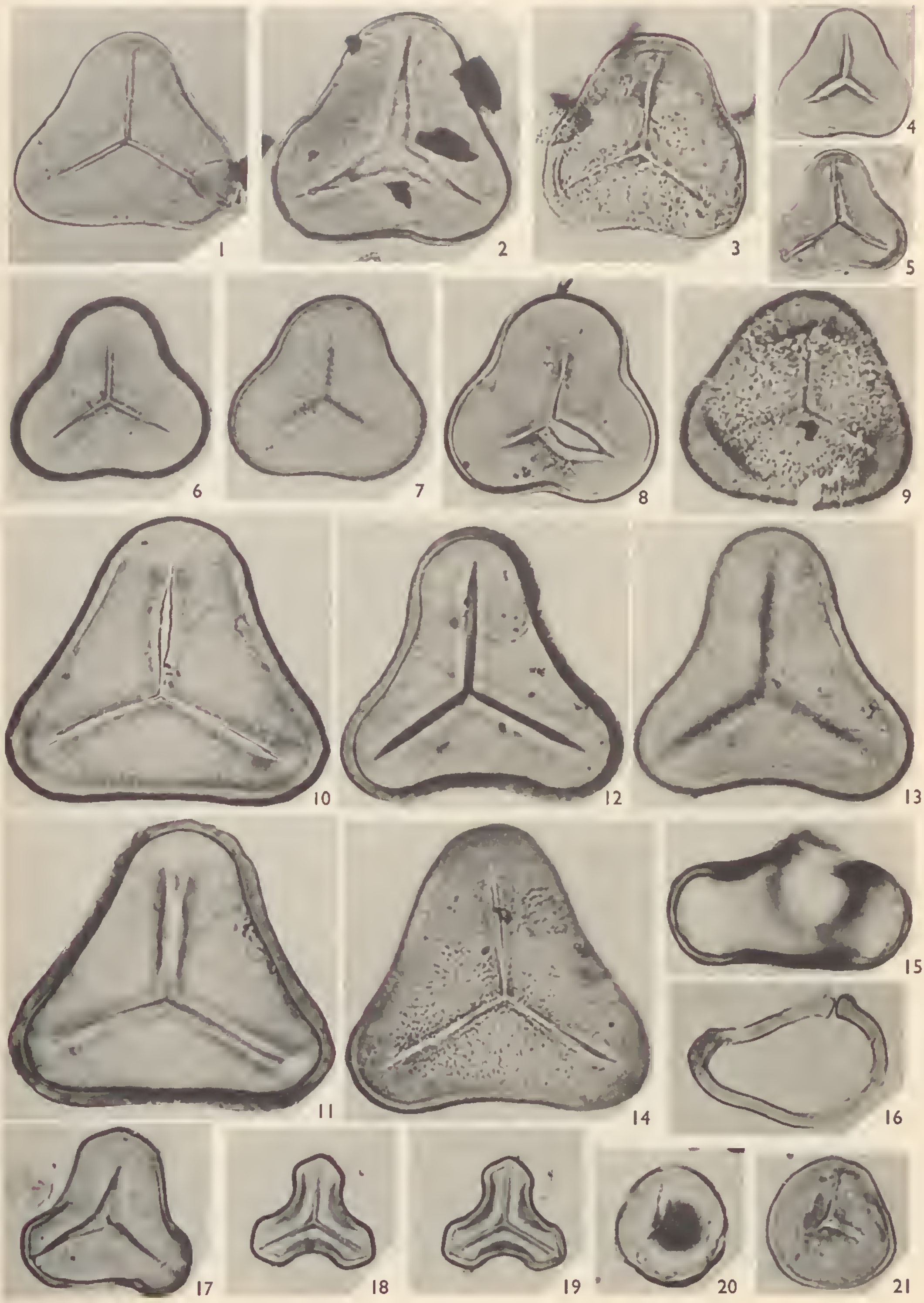
Fig. 21, 22—*Lycopodiumsporites facetus* sp. nov. 21, Distal view; Wonthaggi, Kirrak Area, sample P22599, D139/2 50·5 123·4 (P21987). 22, Optical section of two-layered exine, × 1,000, showing granulate exoexine; Cootabarlow Bore No. 2 at 1,469-70 ft, D302/2 28·3 128·2 (P22021).

Fig. 23-26—*Reticulatisporites pudens* Balme. 23-25, Specimen from Comaum Bore No. 2 at 708 ft, D262/1 39·9 125·0 (P22022); 23, distal surface × 1,000; 24, 25, proximal and distal foci. 26, Distal view; Loxton Bore at 1,465-70 ft, D365/1 25·3 113·4 (P22023).

Plate VIII

All figures × 500 unless otherwise specified; from unretouched negatives.

Fig. 1-7—*Klukisporites scaberis* (Cookson & Dettmann). 1, Proximal view; Cape Paterson, sample P22601, D162/2 32·0 118·6 (P22010). 2, Optical section; Wonthaggi sample P22589, D239/2 41·4 121·0 (P21962). 3-5, Specimen from Robe Bore No. 1 at 4,300 ft, D227b/1 44·8 117·0 (P22024); 3, distal focus; 4, 5, high and low foci of portion of distal reticulum × 1,000. 6, 7, Sections × 1,000 Wonthaggi, Kirrak Area, sample P22599, D139/S72b/1-2 49·1 121·7 and 22·9 121·7 respectively (P22025).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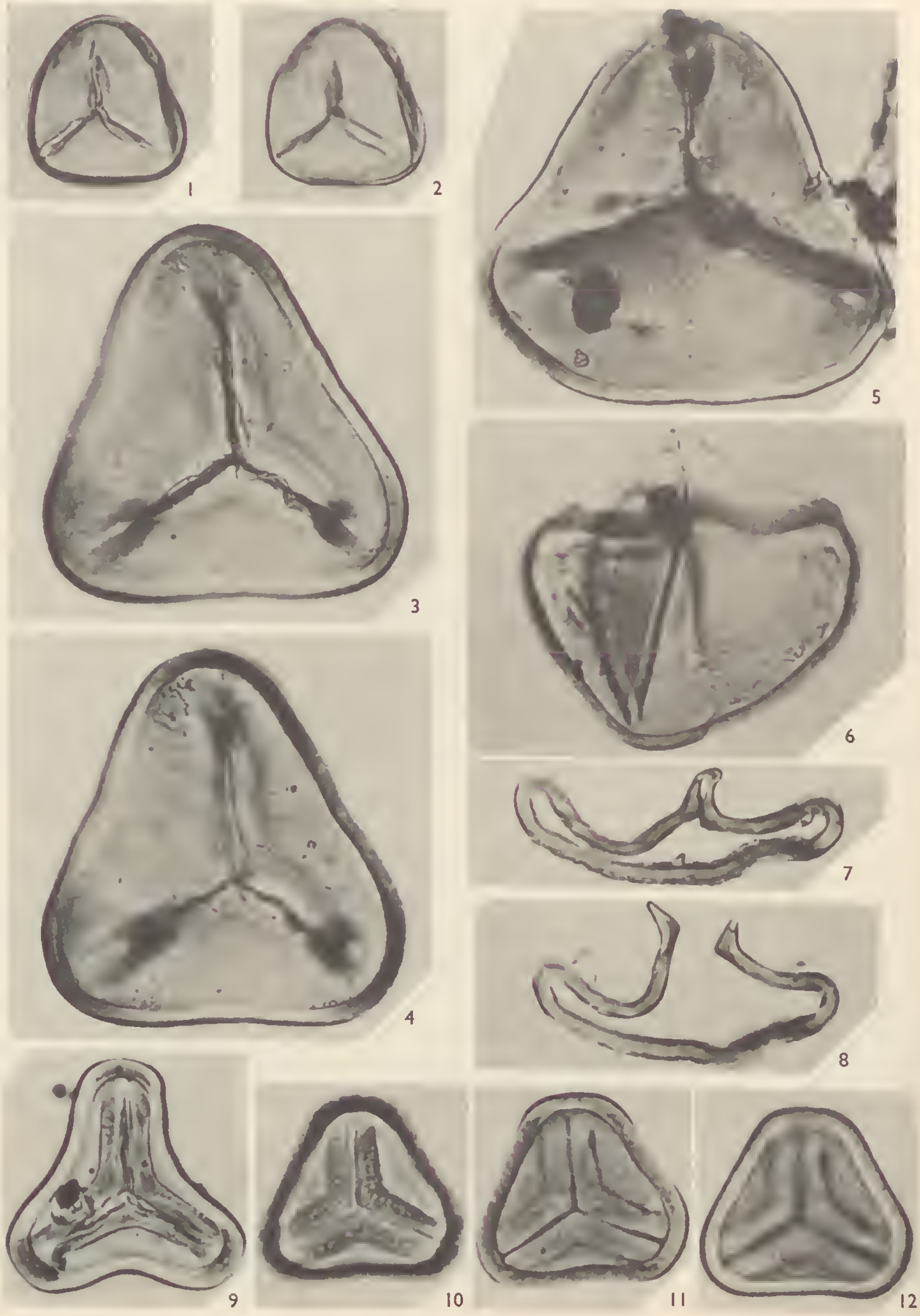
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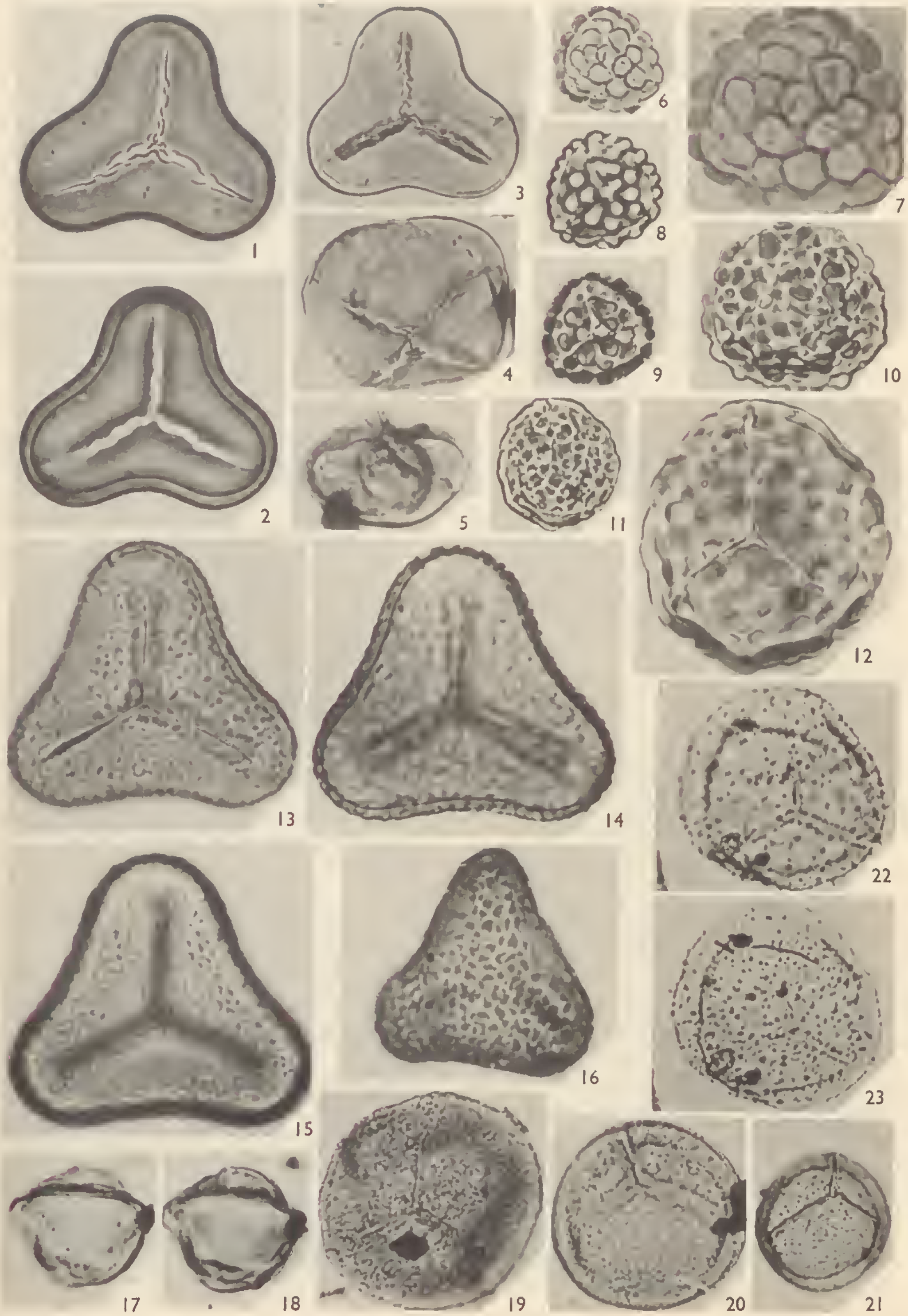
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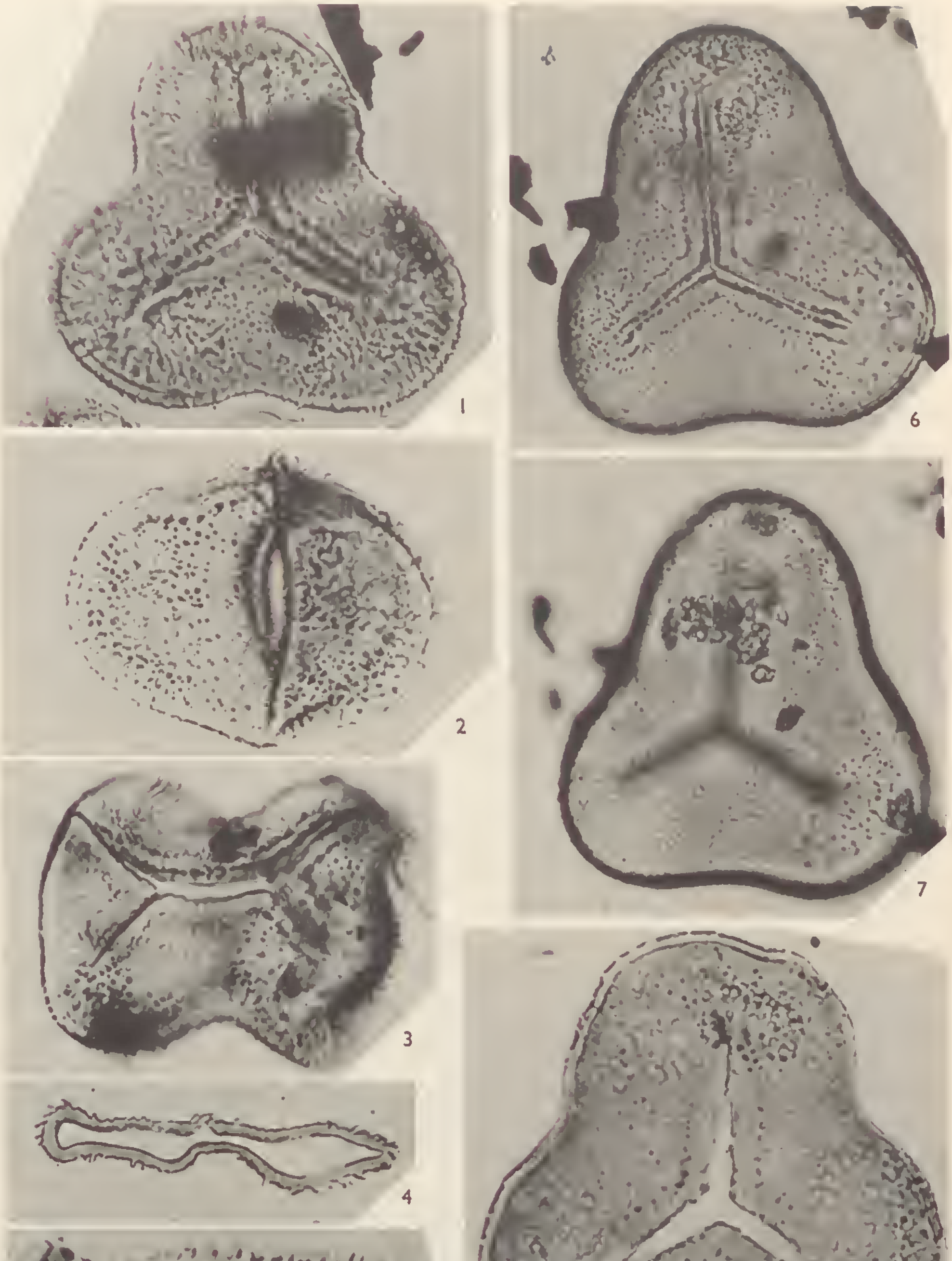
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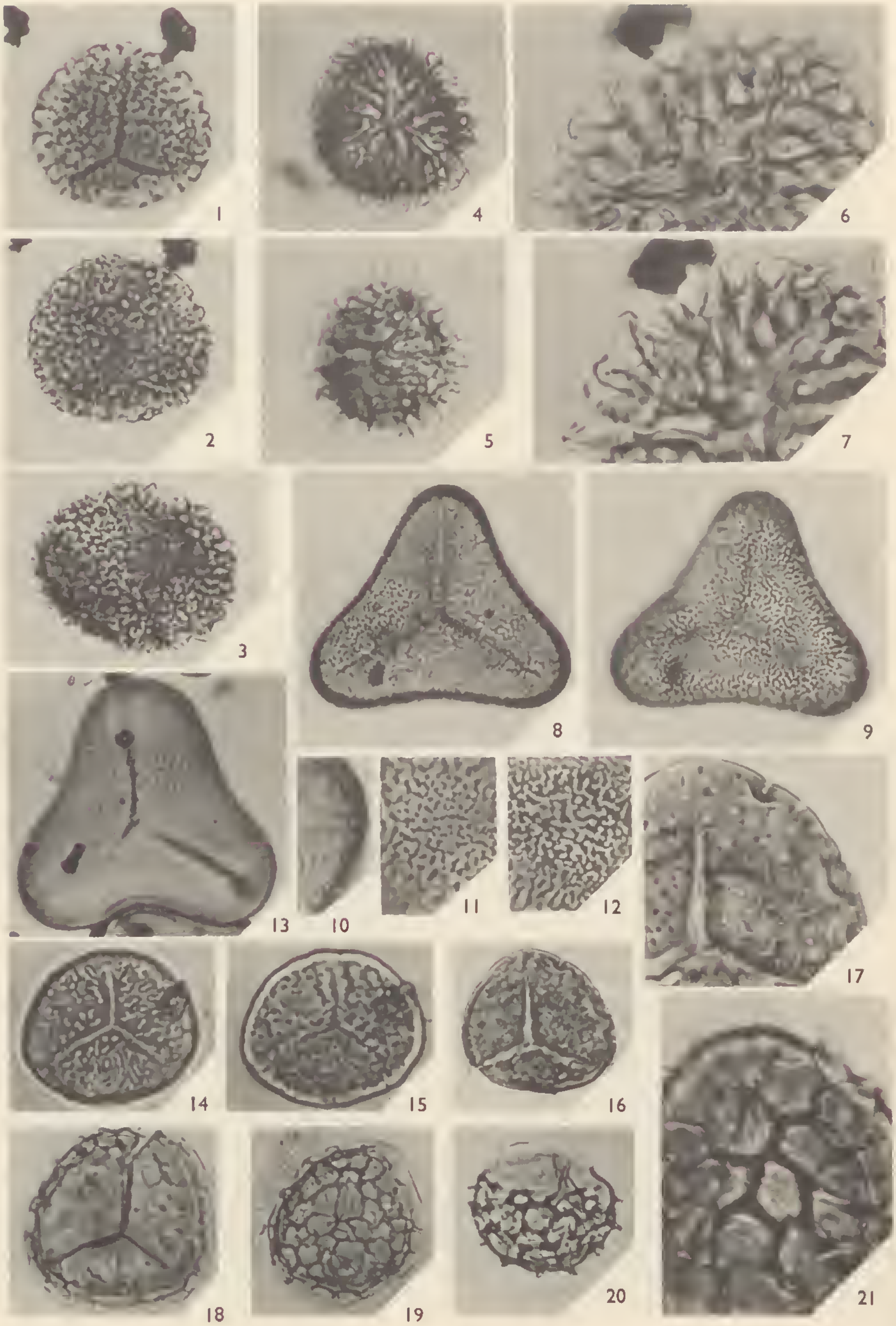
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